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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

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SYNTHETIC ACTION OF RADIUM.

According to the disintegration hypothesis, the break-up of radium liberates enormous quantities of energy, comparatively speaking, and produces at least one simpler product—helium. The reversed process has, of course, been imagined, but to produce complex substances from the simpler ones would require energy in an exceedingly concentrated form. The only known source of energy in this condition is the break-up of radioactive compounds, and it would seem not beyond the bounds of possibility to bring about some form of synthetic action by means of this energy. In a recent important communication to *Nature*, Sir William Ramsay and Mr. W. Ternent Cooke describe what seems to them to be an action of this kind. Some glass bulbs which contained radium bromide were placed in glass beakers for protection. These beakers, although they did not come in contact with the radium salt nor its emanations, were found after some months to be radioactive and the radioactivity could be removed by washing with water. The solution thus formed contained substances which were precipitated in different ways, which substances had apparently been produced by the energy set free from the radium salt.

THE TRIP OF THE VISITING ENGINEERS.

We would urge all electrical engineers who can by any means do so to attend the International Electrical Congress which meets at St. Louis, the week beginning September 12. We would also advise these engineers, as well as those who can not go to St. Louis, to take the trip of inspection which has been arranged by the American Institute of Electrical Engineers for our foreign guests. The time and money spent in this way will be a most profitable investment. The electrical engineer, possibly more than any other, must keep fully abreast with the progress of his profession and one of the most satisfactory methods of doing this is to inspect typical modern installations and systems. This trip will take in Schenectady, Montreal, Niagara Falls, Pittsburg and other important electrical centres, and those who go on it will have not only the opportunity of inspecting some of the most important electrical installations in the world, but will have the benefit of the criticism or commendation of the European engineers as well as of our own. An exceptional opportunity will thus be offered to learn how the foremost electrical engineers of England, France, Germany, Switzerland and Italy will view American practice in construction, erection and operation. Such criticism will undoubtedly be of far greater value than a large amount of time spent in the study of foreign periodicals.

The opportunity to meet and listen to the distinguished electricians and men of science who will attend the congress and present papers is one which comes but a few times in a lifetime, and many of the papers which will be presented there will have additional value to those who have been able to take the visiting trip and to hear many informal discussions. It is hardly necessary to point out again that the papers read at St. Louis will be presented by request and we feel justified in predicting that each and every one of them will be of great value and interest.

Aside from these professional reasons for taking the trip and attending the congress, a rare chance is offered to make many pleasant and helpful acquaintances. All engineers throughout the world are working toward a common end and a common cause and they hold for each other, no matter where each may happen to have his work laid, a feeling of sympathy and regard.

IRON FOR ELECTRICAL PURPOSES.

Several years ago attention was called to the fact that certain alloys of iron had a high permeability and at the same time a high electrical resistance. The value of an iron having these properties was pointed out at the time, hope being expressed that the research would be carried further and some definite progress made. Since then but little has been heard

in this matter, but the report of the Physikalische-Technische Reichsanstalt for the year 1903 calls this to mind again in the statement that in some of the magnetic materials very high ohmic resistance is combined with excellent magnetic properties. It would seem that this field is well worth investigating, since an iron having this characteristic, if otherwise satisfactory, would be a great boon to the designer of electrical apparatus.

THE COMPENSATED SINGLE-PHASE MOTOR.

Electric traction by means of alternating currents enters a new stage with the development to a commercial point of the compensated motor, which has just been exhibited by the General Electric Company, of Schenectady, and which it is said the company is now ready to put into regular service. The motor has been brought to a commercial form, the equipment has been brought to a practical operating shape, and been standardized, and while possibly some changes in minor details may be made, the apparatus as it now stands is ready for introduction into every-day service.

The Compensating Windings.

The motor which is distinguished by the term compensated, is a series motor having, of course, laminated armature and field cores. The winding of the armature is similar to that of a direct-current series motor; high resistance leads are not used in making commutator connections. The field constitutes the novel portion of this machine, as in addition to being laminated, a feature common to all alternating-current motors, it has two windings which are distributed in slots similar to the stator winding of an induction motor. One of these, the compensated winding, which gives the motor its distinguishing name, is placed on the field in such a way as to balance the armature reaction. The armature ampere-turns at every part of the periphery are compensated by an equal number of ampere-turns in this field winding. In other words, the magnetic flux which would be set up by the current flowing in the armature coil is at every point neutralized by this compensating winding, leaving the flux, due to the field coil proper, unaffected. The effect is somewhat similar to the compound winding proposed some years ago by Ryan for direct-current machines.

The Field Winding.

The field winding proper, the function of which is to set up a magnetic flux through the armature, is distributed in slots, this arrangement being more convenient in a motor having a compensated winding.

Operation of Motors on Alternating and Direct Currents.

As far as could be told by watching the motor during operation it runs practically as well on the direct current as on the alternating current. The only difference noticeable was a trifle more sparking at the commutator at the moment of starting with alternating currents than with direct currents, but this lasted only for a moment, and was at no time important. Otherwise it would be impossible to tell upon which system the motor is being operated, since any hum of the transformer or other apparatus due to the alternating current is not noticeable above the ordinary noise of a running car. The method of changing over from direct to alternating current used in the equipment exhibited is simple and neat.

Simplicity of Control.

The simplicity of the series parallel rheostat control and the fact that this is suitable both for the alternating and the direct-current systems, have led to the adoption of this method here. The desirability of operating interurban cars over the city systems now existing is well recognized and to do this it is almost essential that the alternating-current motor should operate satisfactorily upon the standard direct-current system. It is out of the question to discard the present direct-current equipment or to install a second alternating-current trolley. Against the latter plan a number of serious objections may be made. It is undesirable to install a second trolley wire or underground system of supply, and probably in but few instances would this be permitted. City lines will probably be limited to low potentials, and hence may become inefficient or expensive if adapted to transmitting alternating currents. While the first of these two reasons might only apply to conditions as they now exist, the latter applies to all alternating-current traction within the city limits. For these reasons it seems essential that an alternating-current motor should operate on a direct-current system. It must therefore be supplied with direct-current controlling apparatus, and if this same apparatus can be used satisfactorily when the car is running on the high-voltage country districts so much the better. Where stops are not frequent the slightly lower efficiency of the rheostatic control is not a matter of much importance. When the conditions of operation are such that this rheostatic loss is great, voltage control may be used, or over lines where there is no necessity to operate on a direct-current system, there will be no need for the rheostatic control. Such conditions are likely to obtain on converted steam railroads where the right of way through cities is well protected.

A Standard Equipment.

This new traction system as exhibited is noteworthy from the fact that a complete and standardized equipment is now ready. Not only has the motor been brought to a satisfactory point, but all accessory devices are in the same condition. In fact, the only new devices in addition to the motor are the transformer, the commutating switch for changing from direct to alternating currents, the oil switch for use in the high voltage lead to the trolley, and the air-compressor motor. The latter is nothing more than a small compensated motor designed along the same lines as the main motor. The rest of the equipment is practically direct-current apparatus and it can be used wherever the direct-current system is applicable. The equipment as it now stands seems to offer a satisfactory solution of the problem of adapting alternating currents to traction, making available a system suitable for long interurban roads and for heavy trunk lines.

THE INTERNATIONAL ELECTRICAL CONGRESS.

Arrangements are being completed for the holding of the International Electrical Congress at St. Louis, Mo., September 12-17.

The congress will convene in the music hall of the Coliseum, Olive and Thirteenth streets, on Monday, September 12, at 9.30 A. M.

It is intended that immediately after the opening session the congress will divide into sections. The section halls are on the second floor of the music hall. The bureau of information and the office of the secretary and treasurer will also be in the Coliseum. The sections will meet from 9 A. M. to 1 P. M., on Tuesday, Thursday and Friday.

On Wednesday, at 10 A. M., the annual convention of the American Institute of Electrical Engineers will be formally opened at Festival Hall, in the grounds of the Louisiana Purchase Exposition.

In addition, the following societies will hold conventions:

American Physical Society, September 15.

American Electrochemical Society, September 13 and 15.

The American Electrotherapeutic Association, September 15.

The International Association of Municipal Electricians, September 13 and 14.

The National Electric Light Association, the Association of Edison Illuminating Companies, and the United States navy department will send delegates to the congress.

The governments of Austro-Hungary, Italy, Switzerland, Norway and Sweden, Australian colonies, Brazil, India and Mexico have appointed delegates, as have the following foreign national organizations: the British Institution of Electrical Engineers, La Societe Internationale des Electriciens, Associazione Ellettrotecnica Italiana, and Oesterreichische Elektrotechnischer Verein.

The circular tour being arranged by the American Institute of Electrical Engineers for the visiting delegates is securing a number of adherents from the Institute membership. The cost of a ticket for the special tour, including railroad fares, sleeping car berths, hotel accommodations, meals and all necessary expenses from New York and back, will be $150. The secretary of the American Institute of Electrical Engineers, Ralph W. Pope, will receive communications with respect to the circular tour and requests for tickets.

The chairman of the general reception committee, with headquarters in New York, is Mr. John W. Lieb, Jr., president-elect of the American Institute of Electrical Engineers, 55 Duane street, New York city. The chairman of the committee on transportation and arrangements is Mr. E. H. Mullin, 44 Broad street, New York city.

The chairmen of the local reception committees in the order in which the cities to be visited in the circular tour are as follows:

Boston, C. L. Edgar; New York, T. C. Martin; Schenectady, E. W. Rice, Jr.; Montreal, Canada, Professor R. B. Owens; Niagara Falls, George W. Davenport; Chicago, Samuel Insull; St. Louis, W. V. N. Powelson and W. A. Layman; Pittsburg, Charles F. Scott; Washington, General George H. Harries; Philadelphia, Joseph B. McCall.

The local committees have prepared a series of "Guide Books" which will give in detail the engineering and other features of each city visited. These books are being made very complete, and the distribution will be so arranged that the visitor will have ample time to familiarize himself with the chief points of interest before arrival in the city under description.

The visit to Niagara Falls will be made on Friday, September 9, not September 8, as previously announced, the latter day being spent in Montreal.

IN NEW YORK CITY.

The final meeting of the general and local reception committees was held at the office of Mr. John W. Lieb, Jr., in New York city, on Monday of this week. It was estimated that about 120 visiting English and Italian engineers would be here to go on the tour to St. Louis *via* Schenectady, Montreal, Niagara Falls and Chicago. A delegation of members of the American Institute will accompany them. Headquarters for the reception committee were opened at the Waldorf-Astoria Thursday of this week.

The guests of the Institute will consist of members of the Institution of Electrical Engineers, of England, and of the Associazione Ellettrotecnica Italiana. The members of the British society which returns the visit made to England by the Institute in 1900 will land in Boston about September 2. The members of the Italian society arrived in New York this week, and are being entertained on a special programme by the New York Edison Company, proceeding on the evening of September 1 to Boston *via* Newport to join the English contingent of guests and to be entertained there on Saturday, September 3, by the Boston local reception committee. Other arrivals from Europe are expected about the same time, rendezvousing at New York city where the consolidated party from Boston will arrive by Sound steamer Sunday morning, September 4.

The New York reception committee has made arrangements to transfer the guests from the boat, on Sunday morning, direct to their hotels, by conveyances specially provided, and their baggage will also be transferred for them so as to relieve them of all necessity of checking and waiting for it. Sunday morning will be left free for rest and recreation, church attendance, inspection of the city, etc., and guests and participating members of the Institute are invited to visit and register at the official Institute and committee headquarters, suite No. 116, 117, first floor, Waldorf-Astoria (West Thirty-third street front). At the headquarters necessary tickets and badges will be distributed and all information given by the secretaries and committee in charge.

On Sunday afternoon, September 4, by the generous invitation of Mr. J. G. White, member of the committee, a special trip will be given by steamer Richmond of the Starin Transportation Line, to view the scenery of the Hudson river, then at its best in the beauty of the early fall. The steamer will await the party at the foot of West Thirty-fifth street, and all intending to go should be aboard not later than 1.45, as start will be made promptly at 2 P. M. The trip up the Hudson will extend as far as tide and weather permit, and buffet luncheon will be served immediately after the boat leaves the dock. The return trip will include the famous lower bay of New York and part of the course of the international yacht races. Believing that all the visitors would like to see the unique electric lighting effects at Coney Island, Mr. White has arranged to extend the trip to that point, the steamer to dock at one of the piers near "Dreamland." It is proposed to start on the homeward trip to New York sharply at 9.30 P. M., ensuring an arrival in good season at the West Thirty-fifth street pier.

On Monday (Labor Day), September 5, visitors and all members of the Institute desiring to participate are invited to inspect the new subway. The party will assemble at 9.15 A. M. sharp on the steps of the City Hall, in order to take special train furnished courteously by the Interborough Rapid Transit Company, starting from the City Hall station at 9.30

A. M. This train will run up the west side subway to the Fifty-ninth street and Columbus Circle station, at which the party will disembark to proceed to the new Fifty-ninth street power-house of the Interborough company—the latest addition to the current-generating services of Manhattan Island. At 11 A. M. a special steamer of the Long Island Railroad Company will be boarded at the Fifty-eighth street pier of the Interborough company, and the party will then proceed up the Hudson river to the Kingsbridge power plant of the New York City Railway Company. The party will pass by the ship canal to the Harlem river, and at 12.30 P. M. will leave the Kingsbridge plant for the Ninety-sixth street power-house of the New York City Railway Company. During this part of the trip a light collation will be served. At 2 P. M. the party will leave Ninety-sixth street for the Seventy-fourth street or Manhattan Elevated plant of the Interborough company, on the East river; and at 3 P. M. will leave that point for the Thirty-eighth street station of the New York Edison Company. After visiting this centre of generation and distribution of current for light and power all over Manhattan Island, the party will disband. Guides will be furnished at all the different plants by the companies operating them, and data in regard to each will be found in the New York Electrical Handbook given to each guest.

The fact that the visit of guests from abroad coincides with the great Labor Day holiday does not permit the committee to make arrangements for general entertainment other than those mentioned. But with the belief that some of the ladies might find the trip to the power-houses fatiguing, the committee has made provision for their entertainment in other ways, and has provided automobiles in which, under the guidance of the ladies' committee, such of them as desire to do so can visit the parks and drives and take luncheon at these resorts.

On the evening of Monday, September 5, the American Institute of Electrical Engineers, with the cooperation of the New York reception committee, will give a banquet to the Institution of Electrical Engineers, to the visiting officers and members of the Associazione Ellettrotecnica Italiana and other friends from abroad, at the Waldorf-Astoria, at 7 P. M., in the grand ballroom, preceded by a reception in the Astor gallery at 6.30 P. M. As is the custom at Institute dinners, the presence of ladies is especially welcomed.

The European visitors will reach New York on the scheduled return trip on September 21, at 5.30 P. M., leaving two or three days for miscellaneous visiting and sightseeing in New York city. The reception committee will be in session at the Institute headquarters, 95 Liberty street, and will do all in its power to entertain its guests before they sail for home. Mr. T. A. Edison, member of the committee, has kindly extended the hospitality of his laboratory and shops at Orange, N. J., and desires to entertain the party there at lunch. The committee proposes therefore, if agreeable to its guests, to visit the laboratory by special train, September 22 or 23, as may be found most convenient.

Association of Edison Illuminating Companies.

The annual meeting of the Association of Edison Illuminating Companies will be held at the Hotel Wentworth, New Castle, N. H., August 30, 31 and September 1. An interesting programme will be discussed.

The Technology Club, of Syracuse.

On January 6, 1904, the Technology Club, of Syracuse, was organized at Syracuse, N. Y., with a charter membership of 129, including engineers, architects, analytical chemists, metallurgists and geologists. The object of the organization is the promotion of professional and social intercourse among the members.

The club is located at 707 Dillaye Building, where rooms have been suitably furnished for library and social purposes. Meetings are held monthly, except during the months of June, July, August and September. The annual election of officers takes place at the October meeting. The following officers were elected at the organization meeting:

Professor John E. Sweet, president; Dean William Kent, first vice-president; Mr. Henry C. Allen, second vice-president; Mr. Edward N. Trump, Mr. John H. Barr, Mr. Edmund L. French, Mr. James A. Randall, directors; Mr. Alexander T. Brown, treasurer; Mr. A. Frederic Witmer, secretary.

On June 4 last, the club took a trip over the Auburn & Syracuse Electric Railway to Auburn, N. Y., where several large manufacturing plants and the power-house of the above railway were visited. These visits to manufacturing plants are to be made one of the special features of entertainment and instruction.

A Serious Accident to William C. Candee.

Mr. William C. Candee, assistant secretary of the Okonite Company, and son of the manager of the company, Captain Willard L. Candee, was very dangerously injured in a trolley accident on Thursday of last week. A trolley car near the corner of Flatbush and Seventh avenues, Brooklyn, while going at a rapid speed, collided with an ice wagon, and the end of the pole striking Mr. Candee in the forehead, fractured his skull, crushed his nose, and drove fragments of his eyeglasses into the side of his right eye. Mr. Candee was immediately taken to the Seney Hospital and it is believed that the prompt operation there and the careful nursing that followed saved his life. It is now believed that he will recover with scarcely any scars, and that his eyesight will not be affected. Mr. Candee, who was married about two years ago, had just left his wife to start for New York when the accident occurred. Several other passengers in the car were injured, but none so severely as was Mr. Candee.

The Sons of Jove Hold an Initiation.

In connection with the convention of the Ohio Electric Light Association, the Sons of Jove held an initiatory service. This was the first "rejuvenation" held north of the Mason and Dixon line. This organization is made up of men identified with the electrical world. It was first formed in Texas. The meeting in Sandusky was one of the most successful held. Twenty-seven candidates were initiated with splendid pomp and ceremony. The initiatory services were conducted by Jupiter, Frank Warren; Neptune, W. D. Packard; Pluto, P. R. Boole; assistant to Pluto, W. S. Hanley; Vulcan, Philip Cass; Mercury, E. E. Smidt; Hercules, Clarence A. Delafield; Mars, E. E. Kuhlman; assistant to Mars, J. A. Muir; Appolo, W. W. Lovell; Avrenim, Bailey Whipple.

Membership in the society is limited to one thousand, and represents all parts of the United States.

Machinery Day at the World's Fair.

Saturday, September 10, will be Machinery Day at the World's Fair, when those who are particularly interested in mechanical devices will have an unequaled opportunity of studying the many interesting exhibits in the Palace of Machinery. On that day all the machinery there installed will be in operation. This will include steam turbines, steam engines, gas engines, machine tools, woodworking and abrasive machinery, appliances for transporting materials, apparatus for power transmission; in fact, all the exhibits will be shown at work and turning out their products.

NOTES ON TESTING.

BY M. A. SAMMETT.

Whether it be the manufacturing company verifying the results of its design or the operating concern making an acceptance test of the apparatus ordered, with the object of finding if the machine is within the guarantee limits of the manufacturer, precision in the work of testing such apparatus is of great importance.

Considering the fact that the designing engineers are apt to err on machines of special design and that in standard machines the design is based on a certain quality of material which is likely to vary, one would readily see why operating concerns are justified in going to the expense of fitting out a good testing department, in order to know thoroughly the performance of the machines they are purchasing.

In the present instance, the writer intends to call attention to the importance of temperature rise of apparatus under load. Allowing that the performance of the machine in every respect meets the specifications of the designer, and that the apparatus would be acceptable to the purchaser, having met the guarantee, how many operating concerns do go into the trouble of finding this very vital point of the apparatus? The actual temperature of the machine under operating conditions is the criterion of its longevity, and it is just as important a point for an operating concern, if not more so, than the efficiency of the machine.

While it is desirable to have the efficiency as high as best practice can secure, the question of actual temperature is a question of life of the machine, as excessive heat is not conducive to permanency of insulating material. Excessive heat charring and disintegrating the insulating material causes eventually the "breakdown," and it is this maximum temperature which should command our attention.

In all modern well-designed machines, the importance of ample radiation is given proper attention, by making the winding well distributed, and as the determination of maximum temperature is possible only for the manufacturer, who, while experimenting on new types of machines, applies exploring coils in places of maximum temperature, and so derives his data, this method of determining the temperatures of apparatus is out of reach of the purchaser.

The method often employed in a testing room of an operating concern is the determination of temperatures by thermometer. It is needless to say that the latter is as much of a crude and primitive method in determining temperatures of the conductors of the apparatus, as the first method, where exploring coils are used, is accurate and valuable.

As a golden mean between the two,

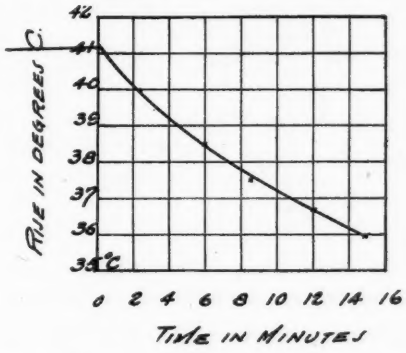


FIG. 1.—RELATION BETWEEN TIME AND DECREASE IN TEMPERATURE OF PRIMARY COILS OF TRANSFORMERS. TRANSFORMER RAN CONTINUOUSLY UNTIL MAXIMUM RISE WAS ATTAINED AND WAS THEN DISCONNECTED.

the method of determining the temperatures by increase of resistance is sufficiently accurate, giving the average temperature rise of the entire coil above the temperature of the surrounding air.

Determining the resistance, it is desirable to use a method which gives the measurements to be taken both quickly and accurately. The galvanometer method, while offering a considerable degree of precision, is rather a slow method, and unless the resistances are taken immediately after the apparatus is disconnected from the circuit, as is the case in transformers, we do not get the actual temperatures, on account of the rapid cooling of the machine as indicated by curve of Fig. 1.

In motors and generators some time is bound to be lost, depending on the relation of the inertia of the revolving element and the friction and windage of the machine. Hence, hourly readings are hardly attainable, except in stationary or non-revolving apparatus.

The drop of the potential method would naturally appear to be the quickest one, when properly used. Ordinarily, the determination by drop of potential is done by using two separate meters—an ampere and a voltmeter. But using two meters two men, as a rule, are necessary in taking readings, and what is more important, there are two meters to get out of order.

As it is of utmost importance to have the meters either exact or carefully calibrated to secure reliable results, a modification of this two-meter method, where only one meter is used, and where the calibration of the meter is of no importance, the results depending entirely on known resistances, is to be described in this article. The method was used by the writer for some time and found absolutely reliable and, though looked upon with some suspicion by representatives of manufacturing companies, in acceptance tests, it gave results very close to those found by the two-meter method with standard instruments. The transformer temperature rises gave a smooth curve, taking in almost all points obtained by this method, thus showing the method to be very accurate. (Fig. 2.)

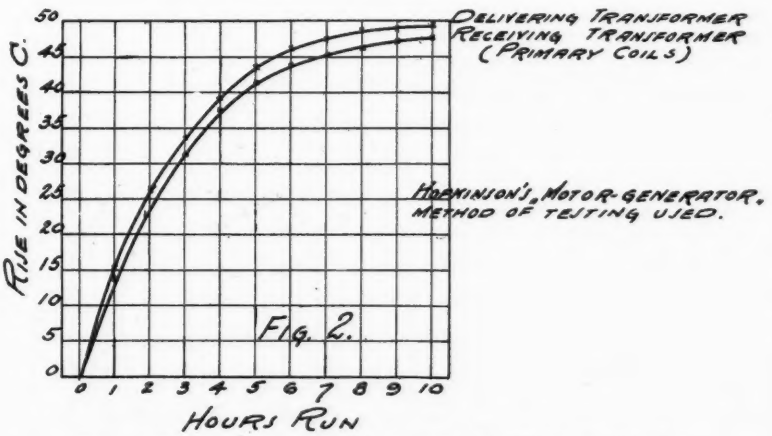


FIG. 2.—HEAT RUN OF FORTY-KILOWATT, 2,200-575-VOLT, 60-CYCLE, OIL-INSULATED TRANSFORMER.

Besides having to use two separate direct-current instruments for the drop of potential method of measuring resistances, when apparatus of widely different resistances is to be tested, a set of two instruments would not answer the purpose satisfactorily, and it would be

necessary to either have a low-reading voltmeter with two or more scales or an ammeter with several shunts.

In the testing department of the General Electric Company, at Schenectady, N. Y., the multiplicity of voltmeters is done away with by the use of a millivoltmeter and a Wheatstone bridge. The known resistances of the bridge are inserted in series with the millivoltmeter and knowing the meter resistance and resistance of leads, which are constant values, and the variable resistance in series, that of the bridge, the voltage for any deflection can be calculated. This enables one to make use of the millivoltmeter for a wide range of voltages.

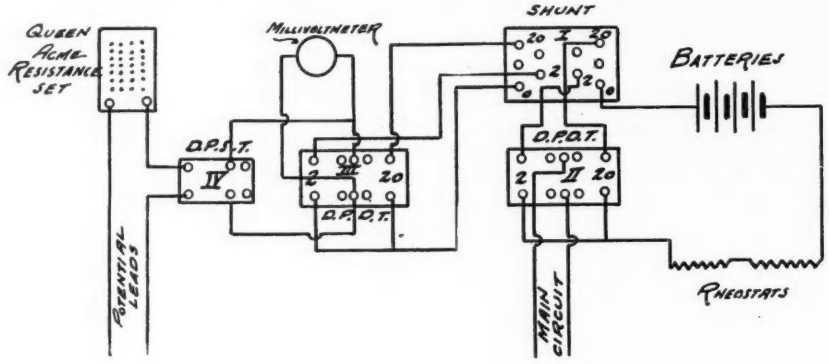


FIG. 3.—DIAGRAM OF CONNECTIONS FOR RESISTANCE MEASUREMENTS BY THE USE OF ONE METER.

Not putting any resistance in series, the meter is used as an ordinary millivoltmeter, giving as its maximum value 100 millivolts, or 0.1 volt. Introducing resistances in series, the highest voltage the meter would read will depend on the resistance available in the bridge. With, say, 11,000 ohms resistance, the maximum voltage that can be read on the same millivoltmeter will be equal to

$$\frac{.100 \times (3.512 + 0.106 + 11{,}000)}{3.512} =$$

313.3 volts

where 3.512 is the meter resistance in ohms; 0.106 resistance of leads in ohms; 11,000 ohms resistance in series with meter and 0.100 full scale indication of the meter.

Though, by this means, a variable voltage range is secured, the method can not be favorably compared with the one, where only one millivoltmeter is used for both current and voltage indications, and the accuracy of the meter done away with.

Suppose we make several shunts so adjusted with the millivoltmeter resistance as to get certain multiples of meter indications expressed in amperes. In that case amperes are equal to meter indications times shunt constant and with a constant electromotive-force supply, as that from storage batteries (see diagram Fig. 3) and with a double set of switches, the meter can be used as an ammeter when switch 3 is closed, and as a voltmeter when switch 4 is closed. During resistance measurements, switches 1 and 2 are closed all the time, while 3 and 4 are closed alternately. Rheostats for either series or multiple connections in series with main circuit are used.

Taking measurements, the current is adjusted for any deflection that may be desired, by the use of rheostats in series with the main circuit and taking the voltage drop the adjustment for the deflection can be made at will by the introduction of resistances in series with the meter. Let us take, for example, the following figures:

Shunt constant for ampere reading, 20; deflection for ampere reading, 0.070; deflection for volt reading, 0.065. Resistance in series with millivoltmeter, while measuring volts drop, seventy-eight ohms.

Temperature of coils measured (cold), twenty-three degrees centigrade.

The resistance of coils from the above data is found by dividing E by C, where

$$E = 0.065 \times \frac{(78.0 + 3.512 + 0.106)}{3.512} =$$

1.510 volts

and $C = 0.070 \times 20 = 1.4$ amps.

$$\text{Then resistance} = \frac{1.510}{1.4} =$$

1.078 ohms at 23° C.

and at 25° C. resistance = 1.085 ohms.

Since we can adjust the deflection of the voltmeter indication at will, we can make it equal to that of the indication of the current and so, equalizing the meter readings, we make the resistance we are measuring to be dependent solely on the bridge resistances, which are known in every case, and the meter and lead resistances, which are constant and the shunt constant.

Having equalized the meter deflections in the formula for the resistance, the values representing volt and ampere deflections cancel out, and the formula reduces to

$$R = \frac{\text{Resistance of bridge} + \text{meter resistance} + \text{leads resistance}}{\text{Meter resistance.}}$$

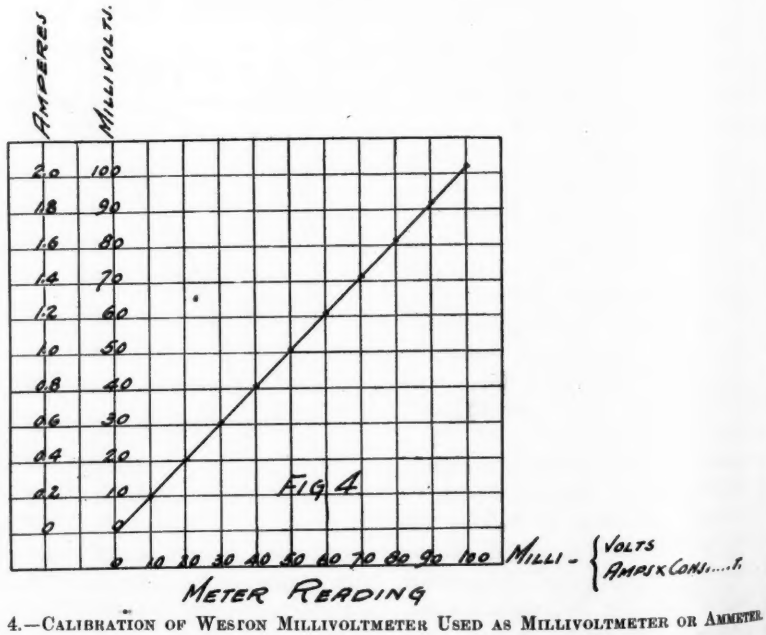


FIG. 4.—CALIBRATION OF WESTON MILLIVOLTMETER USED AS MILLIVOLTMETER OR AMMETER.

This independence of resistance measurements of meter indications is one of the best features of the method. No matter how irregular the meter calibration may be, once equal deflections, by proper adjustment of bridge resistances are ob-

tained, the results are bound to be accurate and no calibration of meter is necessary.

Making a careful check of the millivoltmeter, both as a volt and amperemeter, with standard instruments, the curves were found to be exactly coincident, showing that whatever correction there is to be applied to a certain reading of the meter used as a voltmeter, the same correction will have to be applied to that reading, when used as an ammeter. The meter in both cases having a constant of 1.02 (see curve 4).

With the advantages of reduction of number of meters to only one, requiring one man for taking measurements and with a disregard for meter calibration, the method is one which should prove very useful in every testing room.

Let us now take an example and see how a slight change in one of the measuring meters, using the two-meter method of drop of potential, will affect the result.

Supposing the voltmeter was permanently affected by a stray field, making the voltmeter readings three per cent higher, then measuring the resistance of the primary coils we will get, with the above assumption, a drop of 7.94 volts, with six amperes through the coils, or the resistance will be equal to 1.320 ohms, the room temperature being twenty-one degrees centigrade.

The cold resistance as taken prior to heat run, reduced to twenty-one degrees centigrade, is 1.093. (See table above for receiving transformers.) According to the rules of the standardization committee of the American Institute of Electrical Engineers, the formula to be used for determination of rise of temperature is as follows:

$$R_t = R_o (1 + 0.0042\ t)$$

and $R_{t+\theta} = R_o [1 + 0.0042 (t + \theta)]$

Where R_t = initial resistance at room temperature

$R_{t+\theta}$ = resistance at temperature elevation θ

R_o = inferred resistance at 0° C.

Temperature rise from the above formula is equal to

$$\theta = (238.1 + t) \frac{(R_{t+o} - R_t)}{R_t}$$

Substituting actual values, we get

$$\theta = (238.1 + 21 \frac{(1.320 - 1.093)}{1.093} = 53.8° \text{ C.}$$

And rise above room temperature on basis of twenty-five degrees centigrade will be 54.8 degrees centigrade.

While using the method described in this paper, no matter how large the per cent error of the meter, we get correct results. In this instance, whatever the meter calibration, we will get same results as given in table above.

For the 2.30 P. M. reading, we get a resistance of 1.28 ohms or a temperature rise of only 45.3 degrees centigrade, as against 54.8 degrees centigrade derived in the above example.

This discrepancy is quite considerable, and in order to avoid unreliable results, a method, where the most likely error, that is, the meter accuracy, is eliminated, can not be too strongly recommended.

DELIVERING TRANSFORMER.
Resistance Cold (at 25° C.) = 1.094 Ohms.

Time.	Volts.	Amps.	Room Degrees C.	Primary Resistance in Ohms.	Primary Rise Above Room.	Rise Above Room on Basis of 25° C.
8.30 a. m.	710	18.6	20.5	1.139	15.1	15.4
9.30 "	710	18.6	22.0	1.191	26.2	26.6
10.30 "	710	18.6	22.0	1.22	33.2	33.8
11.30 "	710	18.6	22.0	1.241	38.2	39.0
12.30 p. m.	710	18.6	22.0	1.259	42.6	43.5
1.30 "	575	18.19	21.5	1.27	45.6	46.4
2.30 "	575	18.19	21.0	1.271	46.5	47.4
3.30 "	575	18.19	21.0	1.278	48.0	49.0
4.30 "	575	18.19	21.0	1.278	48.0	49.0
5.30 "	575	18.19	21.0	1 280	48.7	49.6

RECEIVING TRANSFORMER.
Resistance Cold (at 25° C.) = 1.11 Ohms.

Time.	Volts.	Amps.	Room Degrees C.	Primary Resistance in Ohms.	Primary Rise Above Room.	Rise Above Room on Basis of 25° C.
8.30 a. m.	710	18.6	20.5	1.15	13.8	14.1
9.30 "	710	18.6	22.0	1.208	26.0	26.4
10.30 "	710	18.6	22.0	1.228	30.8	31.3
11.30 "	710	18.6	22.0	1.255	37.1	37.7
12.30 p. m.	710	18.6	22.0	1.27	40.7	41.3
1.30 "	575	18.19	21.5	1.279	43.3	44.0
2.30 "	575	18.19	21.0	1.28	44.5	45.3
3.40 "	575	18.19	21.0	1.285	45.5	46.4
4.30 "	575	18.19	21.0	1.290	46.7	47.5
5.30 "	575	18.19	21.0	1.291	47.0	48.0

"ELECTRIC THEORY OF MATTER" (LODGE).

To the Editor of the Electrical Review:

A very pithy saying reads:

Pitiful, that fearing failure, therefore no beginning makes,
For
Who forswears his daily dinner for the chance of stomach-aches!

and, at the same time, a precious gem is the one which reads:

Fellow be with kindly foeman, rather than with friend unkind;
For
Friend and foeman are distinguished not by title but by mind.

and so, as members of the electrical profession have probably read with considerable interest Sir Oliver Lodge's latest exposition of his theories regarding electricity and matter, and on the assumption that we all are more or less startled and groping for light, I ask you to kindly grant me space in your columns for a few remarks bearing thereon—with a view to induce some others to assist in a friendly analysis of Sir Oliver's views.

If I understand rightly, his exposition amounts, fundamentally, to a revival or, to be more correct, an elaboration of the old theory that there are two kinds of electricity. That, more emphatically, matter is electricity; or electricity is matter. That these two electricities (termed, respectively, "positive" and "negative") are composed of atoms. That (terming as material atoms the atoms of what has heretofore been considered matter) a positive atom has the same size as a material atom, while a negative atom (termed an electron) has a size equivalent to 1/1,000,000,000th the size of a material atom. That a positive atom has a massiveness (popularly termed weight) so small as to be considered zero, while an electron has an atomic weight 1/800th of that of hydrogen. That the emanation or radiation from radium is divisible into three classes termed the β, γ and α-rays; that the β-rays consist of electrons, or negative electrical atoms; that the γ-rays are etheral impulses; and that the α-rays are probably composed of atoms of helium.

I take it, from enquiries duly made in the right quarter, that the article appearing in *Harpers Magazine* is a sincere one, though the opinions therein expressed are tentative; and, therefore, that Sir Oliver, knowing that criticism is the soul of progression, will not find too much fault with the ideas of another who, being but a common laborer and delver in science's vineyard, is much less fortunately situated than he.

The article referred to can, in the main,

be divided into two sections; the first dealing with its electrical aspect and the second with its chemical aspect. In order to assist would-be critics, the electrical aspect will be dealt with under subheadings by giving Sir Oliver's theories in detail, each detail being followed by a detail of electrical theories as understood by the writer, and more or less generally accepted; while the chemical aspect will be tersely dealt with in the shape of a few remarks and a suggestion. As it is not possible to quote all of his article, it is necessary to give his views in an abstract form; and no quotation marks will, therefore, be used.

THE UNIVERSE.

1. Lodge—The universe (matter) is composed of electricity and nothing else.

2. General—The universe is composed of matter in conjunction with condition—such as temperature, pressure and electrical conditions.

POSITIVE ELECTRICITY.

3. Lodge—Does not know and does not even guess what it is. Supposes it to be a mode of manifestation or a differentiated portion of the all-pervading ether.

4. General—Is the electrical condition of matter when its degree is above that of arbitrary zero (normal electrical condition). Ether is an hypothetical substance which can not in any way, shape or form be described, or any conception formed of it.

5. Lodge—Appears to exist in lumps the size af atoms of matter; and no portion of it less in bulk than an atom has ever been isolated or appears likely to be isolated. Appears probable that space occupied by unit of positive electricity is not small as compared with the size of a material atom.

6. General—An atom is, hypothetically, the smallest division of matter and has never been isolated or measured.

7. Lodge—Has a massiveness (weight) about zero; perhaps about one per cent of the massiveness of some atoms of matter is due to the positive electricity they contain.

8. General—Electricity being a condition has neither weight nor size. An atom of any particular matter, being, hypothetically, the smallest division of such matter, can not contain any other matter.

NEGATIVE ELECTRICITY.

9. Lodge—Exists in minute particles termed electrons, having 1/1,000,000,000th the cubical size of a material atom such as an hydrogen atom, and an atomic weight 1/800th of that of hydrogen.

10. General—Is a lesser degree of electrical condition than normal electrical condition (arbitrary zero); and, being a condition, has neither weight nor size.

11. Lodge—That an atom of hydrogen contains 800 electrons; and that all other material atoms contain electrons proportionally to their atomic weight. That is, an atom of sodium, having an atomic weight of twenty-three, contains $800 \times 23 = 18{,}400$ electrons.

12. General—An atom of any particular class of matter contains nothing else. If it did, then the atomic hypothesis is upset—although Sir Oliver's deductions are largely based on the atomic hypothesis.

VARIOUS.

13. Lodge—That each electron has a definite charge of electricity.

14. General—That every atom of any class of matter has an electrical condition.

N. B.—Sir Oliver, after defining that negative electricity is material and its construction atomic, states that the atom has an electrical condition (charge of electricity). This brings one back to the beginning again—that the universe consists of matter having condition. For how can an electron (if it is a condition) have a condition? And if it is matter having a condition, then his main theory is difficult to understand, for it apparently holds that all matter is composed of condition.

15. Lodge—Electric currents are due to the locomotion of the little electric charges passing from material atom to material atom of the metals. Such is metallic conduction. In liquid conduction, the electronic atoms travel slowly with the material atoms. In rarefied gases, the electronic atoms fly at a prodigious speed.

16. General—Electrical condition does not travel—it changes in degree; and, thereby, produces induced charges in (or changes in electrical condition of) contiguous matter.

N. B.—Sir Oliver Lodge's idea of metallic conduction is not clear as to whether the charge of electricity is only passed from material atom to material atom of the metal or whether the electrons and the charges of electricity they contain are so passed. Again, if a very long metallic circuit be considered (a large portion of which has a by-path of water) then, according to Sir Oliver, the transmission through the metal will be much quicker than through the by-path of water. But it is a known fact that the amperage of a circuit is just the same at one pole of the generating device as at the other at the same instant. Therefore, electrical transmission through a given circuit (however many paths are in parallel and whatever the paths may be) takes place at the same speed. If not, then in two parallel paths (one of water and one of metal) the energy transmitted by the water would lag behind that transmitted by the metal.

17. Lodge—Electrons suddenly stopped or started or turning a corner excite ethereal ripples. The ripples constitute radiation, of which light is one variety.

18. General—There is no such thing as ether. It is only an hypothetical substance of which absolutely nothing is known. Electrical transmission consists of waves; which, if like light waves, result in vibrations of the matter through which the transmission takes place.

19. Lodge—An electric charge possesses self-induction on which account J. J. Thomson stated that such was equivalent to its possession of mass.

20. General—The term self-induction is, as it is variously used, rather ambiguous.

N. B. (1)—As the Irishman would say, all induction is induction. For self-induction or mutual-induction is a misnomer; and cross-induction is a superfluity. Because induction is the influence of something on something else; that is, the abnormal condition of A enables A to exert an influence on B; for if A and B have both equal and similar conditions, neither one has any influence on the other. Again, as influence of something on something must take place across something, the prefix to influence of "cross" is unnecessary. So, also, is it unnecessary as a prefix to induction. Again, the prefix "self" or "mutual" attached to induction is a misnomer, because such a thing as "self-induction" (or "mutual-induction") is an absurdity.

N. B. (2)—For clearness of explanation, it may be advisable to sometimes use the prefixes molecular and collective with the term induction. Thus energy stored up in a conductor before transmission can take place may be said to be the result of molecular-induction. And the energy which has to be stored up in a conductor which is parallel to another conductor transmitting energy (in order to produce a balance) may be said to be the result of collective-induction. Collective-induction, therefore, is but accumulated molecular-induction across an appreciable thickness of dielectric.

N. B. (3)—Consider steam-practice. The not-being-utilized abnormal pressure of the gases in a boiler is not termed statical pressure. Pressure of gases traveling from a boiler to an engine in operation is not termed current pressure. Pressure of gases supplied to a steam turbine is not termed direct-current pressure. Pressure of gases supplied to a reciprocating (alternating) engine is not termed

alternating-current pressure, because it is supplied first to one side and then to the other side of the piston. The energy stored up by raising the pressure of the internal capacity of a separator (inserted in a pipe-line between a boiler and an engine) to the working pressure of the engine is not termed charge.

N. B. (4)—Incidentally, it may be said that lag and lead of phases are but back electrical effect; lag being the effect of a certain amount of energy stored up to produce a balance of conditions when transmission is increasing; and lead but the discharge of such energy when the transmission is being decreased. The effect is, respectively, to prevent the true increase and decrease of transmission which the generator is endeavoring to force; or, in plainer words, distortion of the impulses. Lag and lead of phase are just the same thing electrically as back pressure is in steam practice; which back pressure results when pressure is applied alternatingly to first one side and then the other side of the piston of a reciprocating engine.

21. Lodge—Positive electrical atoms are about equal in size to material atoms. Material atoms are of such a size that 1,000,000,000,000,000,000,000,000 occupy a space as large as one apothecary's grain and electrons occupy a space so small that 1,000,000,000,000,000,000,000,000,000,000,000 take up no more room than one apothecary's grain.

22. General—A material atom is hypothetical; and so the estimated size of a material atom is only an hypothesis on an hypothesis, as the most delicate instruments can not come anywhere near measuring, even approximately, such small sizes. The size of a positive atom is, therefore, an hypothesis on an hypothesis on an hypothesis. And the size of an electron is an hypothesis upon an hypothesis upon an hypothesis upon an hypothesis.

N. B. (1)—To give some idea of what Sir Oliver's figures mean, suppose that Greater New York had five millions of married couples in it, and that each couple had one thousand children. Now the sun, moon, earth and all the stars with the atmosphere constitute the universe. And if there were one thousand universes, and each universe had one thousand worlds in it, and each world had one thousand United States in it, and each of the United States had one thousand states in it, and each state had one thousand counties in it, and each county had two hundred Greater New Yorks in it, and each New York had five million married couples in it, and each couple had one thousand children, and each child had one million dollars, then all the dollars put together would not make a greater number of dollars than the number of electrons which Sir Oliver says could be contained in such a small space as that occupied by such a small thing as one apothecary's grain.

N. B. (2)—When in connection with any consideration or measurement (and measurement is only consideration mathematically carried out) a halting point is reached beyond which man can not go and an hypothesis is used, such hypothesis becomes the arbitrary zero. Tersely, when absolute zero is unobtainable, a certain plus quantity has to be adopted as arbitrary zero. For instance: in the consideration of the universe, man has to adopt as his arbitrary zero a creator. As he can not define a creator, there comes the halt. Otherwise, he would be attempting the impossible—trying to obtain absolute zero. In temperature, absolute zero is also unobtainable; so the temperature of water at freezing point when the barometer has a certain height is adopted as arbitrary zero. In pressure condition, absolute zero can, practically speaking, be obtained; that is, absolute zero is the pressure of vacuum; but an arbitrary one is more convenient, so the pressure of the atmosphere is used as the zero for practical purposes. In electrical condition, both absolute and arbitrary zero are at present unobtainable—the best arbitrary zero at present obtainable is that of the voltage of the earth; or the voltage of one body can be used as a zero to simultaneously measure, comparatively, the voltages of several other bodies.

N. B. (3)—It appears to me as if we are trying to do too much when we build hypothesis upon hypothesis to the N times; and that it is almost time for us to halt by remembering, with all due reverence to the scriptures, that until we become again as little children, reducing our complexity to simplicity, we shall not enter into the kingdom of the scientific unseen.

CHEMICAL CONSIDERATION.

I think that it will be generally agreed that the work which has been carried out by Sir Oliver Lodge, Dr. Thomson and Professor Rutherford is very valuable; and, if its results do not benefit electricians, there is considerable reason to suppose that it may prove of inestimable value to the chemist. With some hesitation, I suggest for their consideration, as the α-rays are apparently the visible evidence of helium (having, if their calculations are correct, an atomic weight twice that of hydrogen), that perhaps the β-rays are the visible evidence of some hitherto undiscovered element having an atomic weight, if their calculations are correct, of 1/800th that of hydrogen. As to the γ-rays, perhaps they can make some suggestion.

In conclusion, kindly allow me to say that I want those who are interested enough to wade through the intricacies of the subject matter dealt with to criticise what appear to be my opinions remorselessly. As for Sir Oliver's opinions, they must use their own judgment. For if each gives of his cultivation, then, by threshing out the chaff, a little wheat may be obtained from each; which, if all put together, will make up a fine measure of brain food. For it must not be forgotten that

When the miser hides his treasure in the earth, he doeth well;
For he opens up a passage that his soul may sink to hell.
So
Seeing how the soorma wasteth, seeing how the ant-hill grows;
By
Little adding unto little—live, give, learn, as life time goes.
For
Wisdom comes in little lessons—little gains make largest store—
Like
Drops of water falling, falling, falling, brim the chatty o'er.

J. STANLEY RICHMOND.

New York, August 9.

New Form of Diaphragm for Electrolytic Cells.

At a recent meeting of the London Faraday Society, Dr. F. Mollwo Perkin described a new form of diaphragm for electrolytic cells, which seems to have advantages for a certain class of work. The diaphragm is formed of two glazed porcelain cells, one within the other. These are perforated with numerous pin-holes to allow the passage of the electrolyte. When they are to be used, the inner jar is wrapped around with some material such as asbestos paper, the layer being made thick enough to cause the inner jar to fit tightly within the outer. The diaphragm just prepared is then soaked in water or the electrolyte, and is then ready for use. When it is desired to clean it, it is only necessary to remove the inner jar and replace the old layer of asbestos paper by a fresh one. Other materials besides asbestos paper are found suitable. The space between the two jars may be filled with a pulp of blotting paper, parchment, nitrated cotton wool, sand or powdered glass. Some of these materials are not suitable for all electrolytes, but the latter two may be used with the strongest acids and alkalies.

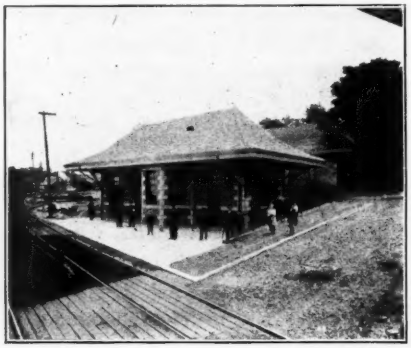
The advantages of this cell are that it is easy to clean the porcelain jars holding the porous material in position, and the combination is quite strong mechanically.

Secretary of Agriculture Wilson has decided to install a wireless telegraph system of fire-alarms in all government forest reserves throughout the country, and thinks that the step will contribute greatly to their preservation.

The Lackawanna & Wyoming Valley Railroad.

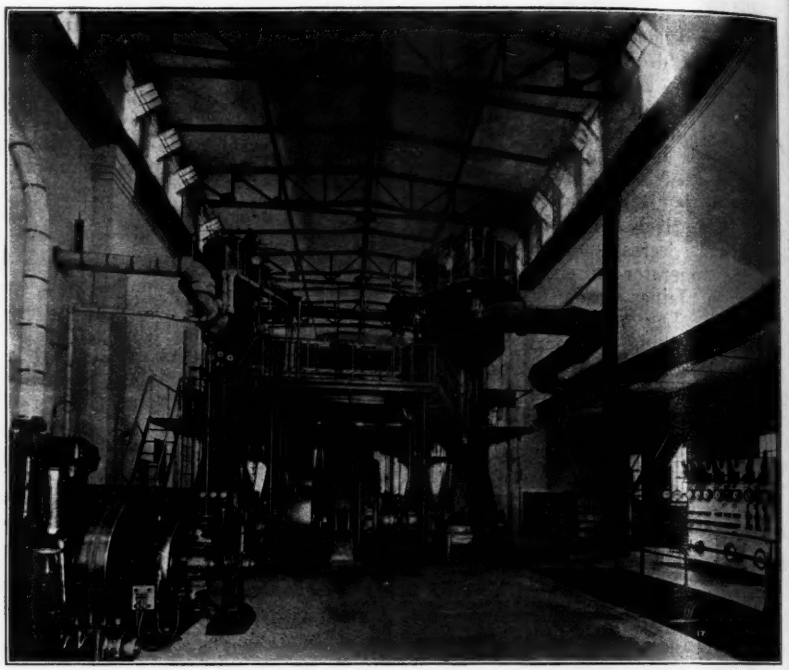
By D. A. Willey.

BETWEEN the cities of Wilkesbarre and Scranton an electric railway has recently been completed which is of more than ordinary interest. One reason is because it is a competitor of no less than five standard-gauge steam railroads which are in operation between the cities mentioned. It is not intended for passenger service merely, but to carry express and ordinary freight. From a technical standpoint it is, perhaps, most interesting on account of the character of its construction. It probably represents the most advanced type of third rail electric traction which has yet been completed in the United States, and it may be said that it was built and equipped with the view of attaining the highest engineering standard.



MARKET STREET PASSENGER STATION, PITTSTON.

The cities referred to are about twenty miles apart and situated in one of the most thickly populated sections of Pennsylvania. Between them are a number of other communities, including Pittston with a population of 25,000 and Carbondale with a population of about 16,000. The promoters of the Lackawanna & Wyoming Valley Railroad, as the system is termed, believe that in spite of the transportation facilities afforded by the steam lines and the local trolley lines, a third-rail system on which express service could be maintained, would prove a profitable venture. After estimates had been made of the cost and the engineering problems solved, the work of constructing the road was commenced under the general supervision of Messrs. Westinghouse, Church, Kerr & Company, chief engineers, and the main section between Scranton and Wilkesbarre was completed in December, 1903. The results obtained from operation have induced the company to make additional extensions which will give a total of forty miles of road, most of it double track.

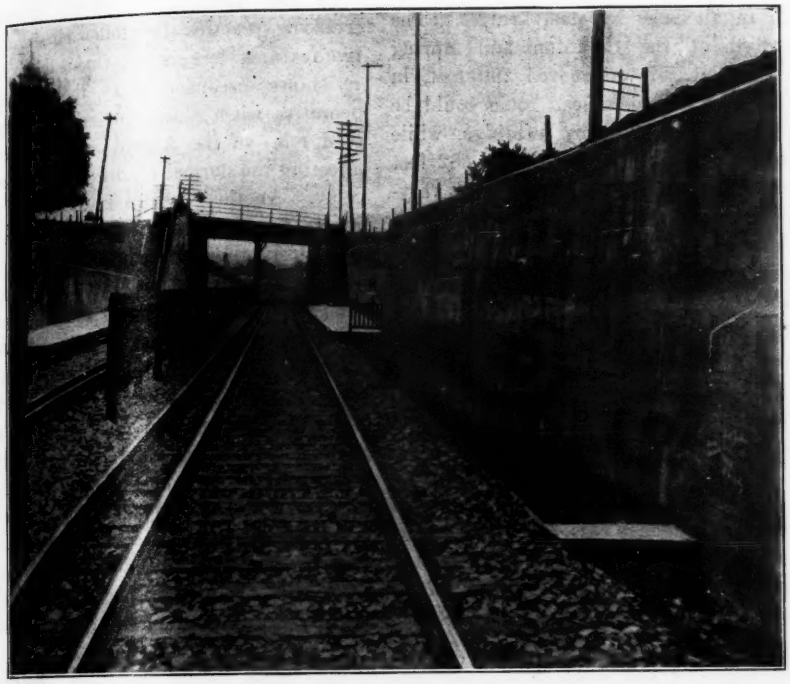


INTERIOR OF ENGINE ROOM AND ONE OF THE MAIN UNITS.

AVOCA VIADUCT.

Terminals have been secured at central points in the cities of Scranton and Wilkesbarre, substantial passenger and freight depots have been erected provided with modern conveniences, and which are on a par with similar buildings found along the larger steam railways of the country. At the principal terminus which is at Scranton, a site comprising about 100 acres has been secured on which have been erected the power station, car house and repair shop, in addition to the depots. It may be said here that the generating units of the power station supply the necessary current for lighting and heating

the various buildings along the route requiring this service. The repair shop is provided with apparatus for wood and metal working as well as two fifteen-ton traveling cranes for handling car bodies and other heavy weights.



PASSENGER PLATFORM IN CUT AT PITTSTON, PA., SHOWING CONCRETE WALLS AT EITHER SIDE OF CUT.

The power-house is arranged to accommodate seven 400-horse-power water-tube boilers of the Babcock & Wilcox type. A standard equipment of Roney mechanical stokers has been provided for the entire boiler plant. These stokers are adapted to burn, with minimum labor, the various grades of coal which the locality provides. The coal is delivered to the station in cars upon a track on a wooden trestle at the sides of the building. Underneath are chutes from which a conveyer leads into the building, automatically distributing its contents the whole length of the coal bunker above the boilers. From this the coal falls by gravity into the stoker hoppers, the supply being controlled by cutoff gates in the coal chutes.

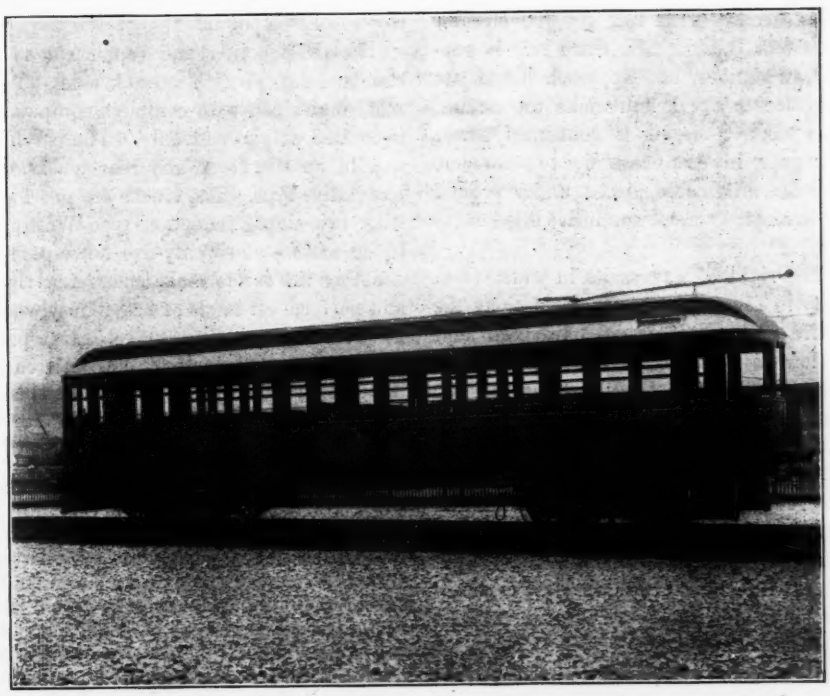
The engine room is arranged to house three main engines of the Westinghouse vertical cross-compound type, with Corliss valve gear. The normal capacity of each engine when running condensing under 160 pounds steam pressure is 2,000 indicated horse-power, with a capacity of sixty per cent overload at high pressures. Each engine is equipped with an alternating-current, direct-current generator of 1,250-kilowatt capacity. The alternating-current end supplies current at a voltage of 390, and the direct-current end a voltage of 650. The generator fields are wound for 125-volt exciter current, which is supplied by a duplicate set of independently driven generators in the engine room, one set being reserved for emergencies.

The switchboards are of white marble two inches thick, set in steel frames. One of these boards is for controlling direct current and distributing it to the circuits for local use at 650 volts, and the other contains the controlling instruments for the low-tension alternating-current circuits before connection with the transformers through which it is sent out on the high-tension transmission lines at a pressure of 22,000 volts.

Compressed air is supplied to the generators and switchboards for removing dust from contact surfaces of switches, etc. A pipe also runs to the car house for cleansing motors, cars, plush car seats, etc., and to the repair shop for the operation of pneumatic tools, hoists, etc.

PASSENGER STATION AT SCRANTON, SHOWING TRACK LOOP.

The high-tension transmission line consists of three No. 4 B. & S. hard-drawn, bare copper wires arranged in equilateral triangle on umbrella type glass insulators, and extends to the substation at Hancock,



PASSENGER COACH.

fourteen miles distant from the power-house. It is carried on thirty to thirty-five-foot cedar poles, set five feet in the ground and spaced 100 feet apart. The substation at Hancock is a building of the same general type of construction as those at the Scranton terminal, and is also arranged and equipped for traffic with passenger and freight rooms along the same general lines as the main stations of the road. The electric equipment necessary for lowering the voltage for conversion into direct current is located in a separate fireproof room and tower.

The road is double tracked from Scranton to Wilkesbarre, with frequent crossovers. The running rails are of ninety pounds A. S. C. E. section. Spring frogs and long-point switches are provided at all crossovers, and rail braces and guard rails are supplied at all curves. The ballast is of broken stone throughout, with a minimum depth of bed under the ties of ten inches. The electric circuit is completed in the track by two 0000 protected rail bonds placed under fish plates. Cross bonds of 250,000 circular mils are placed every 500 feet along the line. The ties are long leaf yellow pine seven feet by nine by eight inches, spaced 2,640 to the mile, and every fifth tie is six inches longer than the others to support the third-rail equipment. The third rail is of seventy-five pounds A. S. C. E. section, and is placed between the tracks. It is bonded with two 400,000 circular mils foot bonds. The third rail is gapped at stations, and approach blocks are provided to break and make the circuit. The electric circuit is continued across the gaps in each case by two 300,000 circular mils cable placed under ground in creosoted wood conduits filled with pitch.

The right of way varies in width from sixty to 150 feet and is enclosed along the entire route. All grades have been kept as low as possible, there being only one grade greater than three and one-half per cent, and this a short one near the station at Pittston. The line has been built as straight as practicable. There is only one twelve-degree curve and such as exist have been made easy by spiraling. The character of construction has necessitated some bold engineering work with extensive fills and heavy cuts through difficult material, largely solid rock. Many of these cuts have required concrete retaining walls to make them secure. One of the most difficult is at Pittston. This is about 1,000 feet long with a maximum depth of twenty-four feet, and was made through rock and hardpan.

The viaduct construction required some very large bridges for an electric railway. Between Scranton and Pittston alone the line of the Erie Railroad is crossed seven times, five times over and twice under and in all cases by steel bridges. The roadbed of the Scranton and Spring Brook Railroad was moved 200 feet, in order that sufficient head room could be obtained to cross it by a bridge, while there is a steel viaduct at Avoca 682 feet long, composed of eight girder spans varying in length from fifty to 102 feet, with a maximum height of eighty-three feet. This structure crosses a ravine in which are located the tracks of the Scranton Traction Company's railroad, Millers Creek Railroad, the Delaware and Hudson Canal Company's double track railroad and five tracks of the Lehigh Valley Railroad.

The electric car equipment consists of exclusive passenger cars, combination passenger and baggage cars, freight cars, and one construction and repair car. All of these cars were built from special designs and are practically of the same dimensions, forty-two feet long over end panels, and fifty-two feet long over platforms. They are electrically heated and lighted. The trucks are of the M. C. B. swing motion, equalized bolster type, and those at the rear have mounted on them with Gibbs cradle suspension, two single reduction Westinghouse motors representing 150 horse-power.

The construction and repair car is a standard flat car with movable sides. The motorman's cab with complete equipment is located at one end only. The car has a pilot on the front and rear trucks, of locomotive type. The trucks are provided with two single reduction type Westinghouse motors of seventy-five horse-power, enabling the car to make emergency runs and perform all kinds of heavy duty, such as wrecking, hauling gravel cars, performing snow plow work, etc. All cars, in addition to the third-rail contact shoes, are supplied with trolley poles, by which they are operated in the car house and yards.

The motor equipment of the rolling stock is sufficiently powerful to maintain a train schedule which is practically equal to that of the fast trains on the steam lines between the cities. Provision is also made for what would ordinarily be called accommodation service, stops being made at convenient points in the various towns and in the open country where it is impracticable for accommodation trains on competing lines to make halts. During the day electric trains run at intervals of ten and twenty minutes, according to the requirements, while extra cars are provided for special occasions.

TELEPHONE ENGINEERING—X.

BY J. C. KELSEY.

THE KELLOGG TRUNK.

In the development of the licensee trunking practice, the following distinctive features were shown. One is the high-resistance disconnect relay, that becomes operative when placed in series with the cord relay of the A cord circuit without affecting the normal condition of the cord relay. Another feature is the use of a relay, for disconnecting the automatic busy testing device, when upon connection, dispensing not only with a listening key, but with plug switches as well. And finally the use of what is ordinarily the supervisory relay, which not only causes the high resistance relay to be short-circuited, but operates upon what can be called a locking relay. In A practice the supervisory lamp must necessarily light after the called party has hung up his receiver. In B practice the lamp, when once indicating that the called party has answered, is extinguished for all time during the connection to prevent operating confusion by superfluous signaling.

At first sight of the Kellogg trunk, the student of circuit conditions questions the use of the repeating coil. He has been given to understand that the system makes use of retardation coils and condensers. Then why not condensers instead of the repeating coil shown in Fig. 16. Condensers by reason of their construction and location in the circuit can not stop the flow of earth currents throughout the trunk circuit. Earth currents are fluctuating in character, hence their passage from the ground at the B battery through the trunk circuit to the ground at the A battery. And it has been shown that it is absolutely necessary to dispense with earth currents, as the best disposed circuits are rendered noisy. The repeating coil will not transmit the fluctuating earth currents, as both terminals of the half of the coil are of the same potential, hence no current will flow.

When a call for a B party occurs, the operator depresses the order key OK. This places her telephone set in inductive relation with the B operator set, through the medium of the repeating coil. If the trunk call is made at night, or when the operator has left the position at B, the usual way has been shown to be to ring on the order line, and throw down a drop, which would cause a pilot lamp to light, and the night bell to ring. But this system improves upon that method, and the A operator at all times has but to depress

the order button. On the order wire is bridged a key PLK, which when thrown places battery on the circuit through the tandem windings of 500 ohms each. The pilot relay PR is wound with equal turns and resistance to effect a balanced condition on the order line. If the relay had unequal windings, the order line would be too noisy for usage. The contacts of relay PR close the circuit of a twenty-volt lamp, which gets its energy through the night bell windings. Therefore, when the B operator leaves the switch and throws the key PLK, the simple act of any A operator depressing her order key, will cause the B pilot lamp to be lighted and the night bell to be rung. The condenser K is placed in the centre of the repeating coil windings to prevent the repeating coil from short-circuiting the relay PR

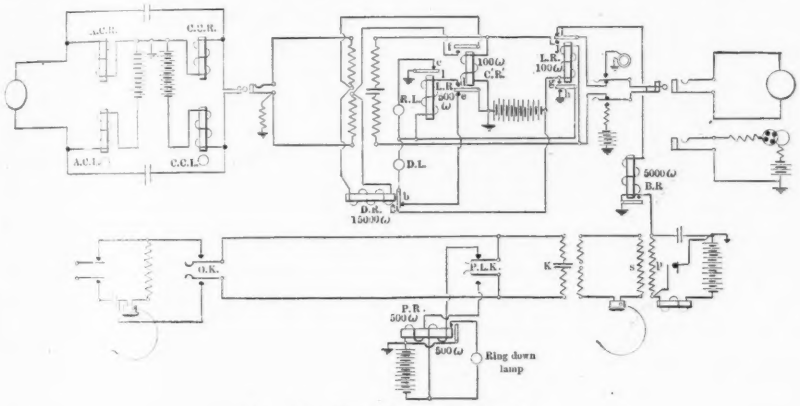


FIG. 16.—THE KELLOGG TRUNK.

and making a permanent pilot signal at night.

The right side of the order wire repeating coil closes the receiver circuit, so that the B operator may hear the busy test clicks which are given in the same manner as described in the A circuit. Without the repeating coil the B operator could only hear the test made while some A operator is in communication with her. B assigns the trunk number and proceeds to test. If not busy, the touching of the tip to a grounded sleeve will not cause any current to flow through BR, hence no click is heard.

While B is in the act of testing, we will assume that A has inserted her calling plug into the trunk. That will cause her own supervisory lamp to light, and also to put a battery potential on the trunk line. The current will then flow through relay DR, having a resistance of 15,000 ohms. Relay CCR at A will not be affected, as the current flowing is too weak. But DR will be energized, and will pull up its contacts. Then battery will flow through contact *a*, through disconnect lamp DL, to ground at *h*, a lower contact of relay CR. This will light DL.

B inserts her trunk plug in the desired jack, and proceeds to ring at once, because she has seen DL lighted. The insertion of that plug extinguishes DL, because the relay CR has been placed in series with the cut-off relay of the desired line and actuated. The actuation of CR changes the contacts at *h* and *i* to *j* and *g* respectively. Changing from *i* to *j* simply closes the talking circuit and cuts off the busy test devices. The changing of contacts *h* to *g* causes the battery to meet the battery, which had been flowing through DL at the point *a*, hence the lamp DL is darkened. The insertion of the trunk plug has also caused the lamp RL to be lighted. The battery flows through contact *a* at CR through RL and contact *c* at relay LR to ground. The only function of RL is to signify to the B operator that the party has answered. Having no further use, it is disposed of.

When the party answers his call, the battery current has a path through the relay C′R′, which energizes it. This closes the contact at *f*, which short-circuits the relay DR and lowers the trunk resistance within the working limits of relay CCR at A. The operation of CCR puts out the lamp CCL and also the lamp RL at B. The changing of contacts *d* and *e* causes the current to flow through the relay LR to ground and energizing it. It breaks the contact *c* of the lamp RL and it goes out. The relay armature, once drawn to contact *l*, makes a self-contained circuit, regardless of the ground at the contact *d*. When contact *d* is removed by the deenergization of C′R′, the relay LR is locked through its own connections. It will not release itself until the circuit is broken at contact *g* of CR.

When the subscriber hangs up his receiver, the relay C′R′ becomes deenergized, opening contact *f* which removes the short-circuit from DR, whose high resistance again comes into play, weakening the current to such a degree that relay CCR at A releases its armature. When A gets both disconnect signals, she withdraws her plug, which deenergizes DR, lighting lamp DL, with current flowing through contact *g*, lamp DL, contact *b* of DR, contact *e* of C′R′, thence to ground. When DL lights B pulls down the connection.

Some question arises as to the use of the lower contact *e* of relay C′R′. It is there for the reason that when the B subscriber removes his receiver, the contact *f* of C′R′ short-circuits the relay DR. If the relay DR should become demagnetized by this short-circuiting, the armature would fall back to normal, touching contact *b*. If contact *b* connected directly with ground instead of ground through contact *e*, then the lamp DL would light when the party answered and give the operator a false disconnect signal. DL would light by battery flowing from contact *g* at CR contact *b*, thence to ground, but if DR is deenergized, it is only at the time that C′R′ is energized and the circuit open at point *e*, making it impossible for a false disconnect signal to be given.

The ringing is done as in the A circuit. The generator current passes out on the tip, while the battery flows through a 190-ohm impedance to the ring side, thereby energizing the cutoff relay temporarily.

If the line is busy, the operator receives the customary busy clicks. Having no power to listen in on her trunk connections, she uses the busy back devices. Y is the busy back device in which the circuit is open and closed three times each revolution. If the operator plugged into the busy back jack, having stopped revolving, the lamp RL would light, just the same as when she would plug into a subscriber's line. The current flows from battery through relay CR, thence to ground, energizing it. This causes the battery to flow through lamp RL at contact *c* of LR. If the busy back would rotate, the line would be short-circuited and the relay C′R′ energized just as when a called party removes the telephone from the hook. As the busy back revolves unceasingly, the circuit would be alternately broken, the relay C′R′ alternately operated, which in turn would alternately energize the relay CCR at A. The A operator knowing the speed of the lamp flashing, tells the subscriber of the fact. The first interruption had operated C′R′, which at once acted on relay LR and lock-

ed it up. The lamp RL would go out at once and stay out. Only the withdrawal of the A plug will cause the lamp DL to light, which tells B that her busy back signal has been regarded.

If the party does not answer, the operator inserts the plug into a jack connecting with a slower interrupter. The actions are the same as the busy back, so far as the B operator is concerned. The first interruption puts out the lamp RL, and the B operator waits for disconnect from A. At A the supervisory lamp CCL will flash twice as fast as the busy signal, whereupon the A operator tells the subscriber that the party does not answer. The sleeve of the trunk multiple jack is grounded through a 500-ohm impedance, which takes the place of the cutoff relay winding on the normal subscriber's connection.

A close examination of a trunk circuit necessarily reveals the characteristic of the A circuit. In the A circuit there are two 100-ohm relays, one connected to the sleeve side and the other to the tip side. The one on the sleeve side works in conjunction with the cutoff relay and disassociates the busy test apparatus. The trunk circuit has the same 100 ohm in the same relation to the circuit. The relay CR works in conjunction with COR, and disassociates the busy test device from the circuit. When the subscriber answers the telephone call, the relays on the tip side do virtually the same work. The relay at A causes the supervisory lamp to be put out. The relay at B causes the supervisory lamp to be put out also, but, in addition, short-circuits the condenser and passes the signal back to A. The difference in the A and B practice lies in the addition of two relays, the locking relay and the high-resistance disconnect relay. With the A circuit of any system known, it is a simple matter to devise the B circuit. In addition to the normal A relays, the two above named relays will carry out all the necessary trunking conditions. In all circuits, it is necessary to have the relay, which will disassociate the test, the relay that will indicate the answering of the subscriber, the locking relay and the high-resistance relays. Under four relays there is a certainty that necessary operating functions are being neglected.

The Kellogg company has a highly developed automatic machine ringing trunk circuit, but this service is connected with the English practice.

The use of a pilot lamp in the disconnect lamp circuit gives a little assistance to the operator in the rapid disconnection of parties. It is usually a red lamp and quite conspicuous.

As in the Bell trunk, the high-resistance relay is a weak spot. There is trouble in the adjustment, and when adjusted so closely, the trouble of sticking is encountered. When one considers that the current flowing through the windings is but one-eight hundredth of an ampere, he will see that adjustment has to be fine. An occasional transposition of the trunk line will not affect the signaling in anv way, which may be said to be a slight advantage.

If the harmonic four-party line ringing is adopted for any exchange, a four-party key is placed in the circuit instead of the single-party key shown. The ringing in done out on the tip side, exactly as in the single-party ring. Mr. Dean has arranged four reed tongued bell tappers to respond to their respective frequencies, which is very successful, requiring no grounds or adjustments. The only difference between the bells of different frequencies lies in the size of the tapper; the heaviest tapper naturally responding to the lowest frequency.

If the two-party selective device is used, two keys would be used. One key serves to send alternating current out on the tip side of the line, while the other key sends a pulsating current out on the ring side. The pulsating current holds the cutoff relay during ringing, while the selective bell on the ring side receives alternating current owing to the condenser in the ringer circuit.

This trunk reflects the greatest credit upon its designers, and may be said to be the least complicated and most reliable circuit operating under the standard two signal trunk specifications.

Tests of High-Speed Centrifugal Pumps.

A test of the De Laval centrifugal pumps has been made by Messrs. J. E. Denton and William Kent, of Syracuse, N. Y. This is the pump referred to in the ELECTRICAL REVIEW for August 6, page 202, in an abstract of a report made by Mr. M. K. Sosnowski to the Société d'Encouragement pour l'Industrie Nationale. The results were obtained when the pump was driven at a high speed by direct-connection to a steam turbine.

Messrs. Denton and Kent tested three types of pump. The first was the single-stage centrifugal pump designed for the delivery of 1,700 gallons per minute and a lift of 100 feet, when running at 1,545 revolutions per minute. This was driven by a fifty-five-horse-power steam turbine through direct-connection with the geared shaft. The second pump tested was a single-stage pump, direct-connected to a twenty-horse-power electric motor designed for 1,200 gallons per minute delivery with a lift of forty-five feet, at 2,000 revolutions per minute. The third pump was a two-stage designed for high pressure, with a delivery of 250 gallons per minute and a lift of 700 feet. The first-stage pump was driven at a speed of 2,050 revolutions per minute by direct-connection to the shaft of a De Laval steam turbine. The second-stage consists of a small pump driven at 20,500 revolutions per minute by direct-connection to the high-speed shaft of the turbine.

It was endeavored in these tests to measure the efficiency of the pumps and to determine the economy of steam-driven pumps. The method of conducting the tests and the results are given in a pamphlet published by the De Laval company.

The efficiency of the large pump—that having a delivery of 1,700 gallons per minute—ranged from 74.3 to 75.6 per cent for delivery between 1,398 and 1,860 gallons per minute. It decreased as the delivery was either increased or decreased beyond these limits. The duty pump, when the turbine was running condensing, ranged from sixty to 61.86 millions of foot-pounds per thousand pounds of steam within the same limits. Tests of the electrically driven pump show that the efficiency ranged from 71.4 for the maximum delivery of 1,403 gallons per minute to seventy-five for the delivery of 1,133 gallons, falling to 68.3 for the delivery of 790 gallons. The electrical horse-power varied from 20.11 to 17.88, the corresponding brake-horse-power being 17.14 and 14.94.

The duty of the two-stage pump in millions of foot-pounds was a maximum of 48.88 for delivery at the highest head of 781 feet. With a delivery of 244 gallons per minute this fell to 41.55 for 328 gallons delivery at 494 feet head, and to 18.63 millions for a maximum delivery of 373 gallons with a head of 136 feet. The steam per water-horse-power per hour ranged from 40.5 for maximum horse-power at highest head to 106.2 for the lowest head and horse-power. This lowest horse-power is only about one-quarter of the highest horse-power delivered by the pump. Both the electrically driven and the two-stage pumps realize their maximum efficiencies with the designed conditions of lift and water delivery.

The Single-Phase Compensated Motor.

Exhibit of the General Electric Company's Alternating-Current Traction Equipment.

An exhibition of the new single-phase railway motor which has been developed by the General Electric Company, of Schenectady, N. Y., was given to a number of representatives of the engineering press at Schenectady on August 19. A party from New York left that city at 8.35 A. M. on a special car over the New York Central road. Mr. E. H. Mullen, of the General Electric Company, and Mr. J. K. LeBaron, editor of the *Four Track News*, were in charge.

Upon reaching Schenectady lunch was tendered to the party at the barns of the Schenectady Railway Company, and after this they were taken on a special car, equipped with the new apparatus, for a run over the new division of the Schenectady Railway Company system, which extends to Ballston Spa, a distance of about sixteen miles. This road has been opened this summer, and is now being operated with the standard direct-current interurban apparatus.

For the purpose of testing the new alternating-current motor, a second trolley wire has been erected over each track

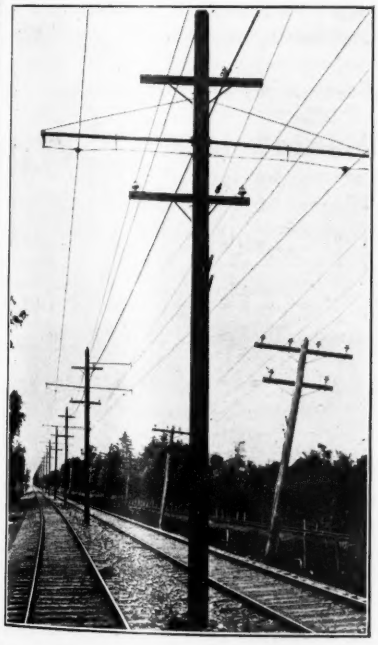


FIG. 2.—VIEW ON BALLSTON LINE OF SCHENECTADY RAILWAY COMPANY, SHOWING BOTH DIRECT AND ALTERNATING-CURRENT TROLLEY LINES.

from which the alternating current is taken.

The run over this road was made without any hitch and the operation of the motor was demonstrated both on alternating and direct currents. The car returned to Schenectady and the party for New York were transferred to another car which carried them over the high-speed line to Albany, where they again took the special car to New York. The entire trip was exceedingly pleasant and was made without any delay whatever. The members of the party showed a keen interest in the new equipment and were greatly pleased with its operation and appearance.

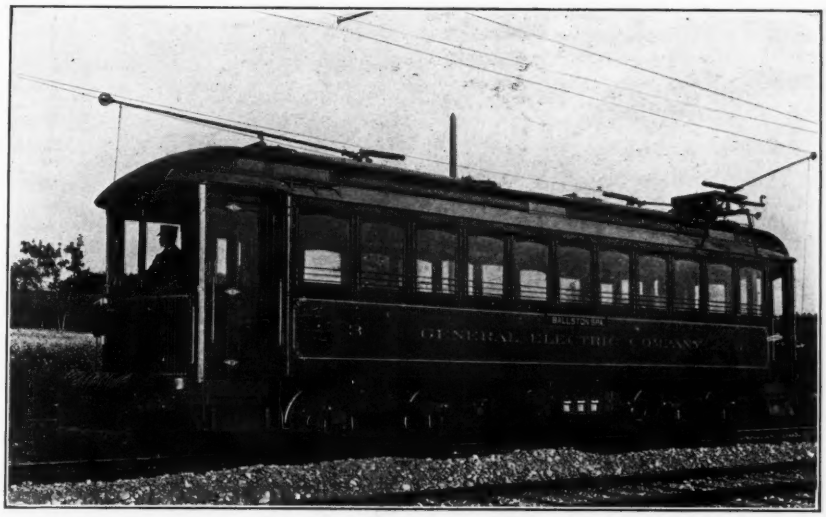


FIG. 1.—CAR OF THE SCHENECTADY RAILWAY COMPANY FITTED WITH SINGLE-PHASE ALTERNATING-CURRENT COMPENSATED MOTOR EQUIPMENT.

The alternating-current motor as developed by the General Electric Company and installed on the Ballston line is of the "compensated" type, so named on account of the character of the field winding, which neutralizes or compensates for the armature reaction. Both the compensated motors and control are adapted for operation on the 2,000-volt alternating-current trolley between cities and the standard 600-volt direct-current trolley in Schenectady. This ability of the compensated motor equipments to run over tracks equipped with either alternating-current or direct-current trolley makes their field of application very broad, as the cars can secure all the benefit of running over existing city tracks without in any way sacrificing their running qualities upon suburban sections equipped with alternating-current trolley.

The compensated motor is essentially a variable-speed motor, the speed-torque characteristic being very similar to that of the direct-current series motor, while its commutating qualities and method of control prove equally satisfactory.

On the Ballston extension of the Schenectady Railway advantage is taken of the ability of the compensated motor to operate with either alternating or direct current. The extension is 15.5 miles in length, including 3.9 miles of city running in Schenectady over tracks equipped with direct-current trolley.

Centre pole bracket construction is used, there being two brackets supporting the two 600-volt direct-current trolley wires and a cross-arm supporting the two 2,200-volt alternating-current trolley wires. The Ballston extension has been operated for several months with direct-current equipments, and their operation being continued in part necessitated an additional set of trolley wires for the alternating-current equipments which would not interfere with the direct-current trolleys. The centre poles are thirty-four feet long and are spaced 100 feet apart, the alternating-current and direct-current trolley wires being No. 000 grooved section with no feeders for the alternating-current trolley and with a 500,000 circular mils feeder reenforcing the direct-current trolley. The direct-current trolley conforms to standard bracket construction and presents no unusual features, while the alternating-current trolley wire is suspended from a three-eighths-inch steel catenary. The alternating-current trolley is clipped to the catenary midway between poles, and

the catenary in turn is hung over porcelain insulators on wooden cross-arms, the whole forming a construction of great flexibility, with the further advantage of providing excellent insulation with standard porcelain insulators and eliminating the span wires adjacent to the trolley wire, thereby preventing the pole catching should the trolley-wheel leave the wire.

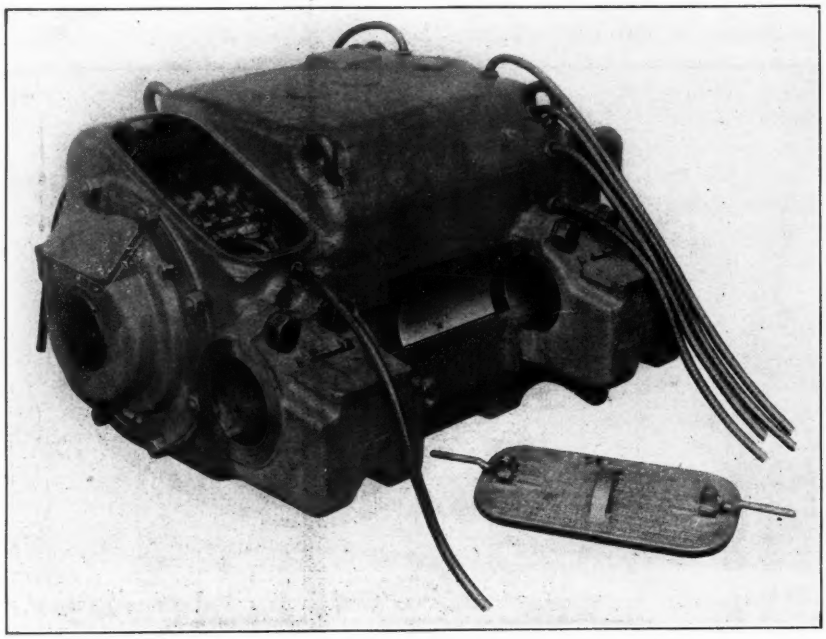


FIG. 3.—THE SINGLE-PHASE ALTERNATING-CURRENT RAILWAY MOTOR DESIGNATED AS THE COMPENSATED TYPE.

With the alternating-current system using a trolley and track return there is an inductive drop in the trolley and rails with an additional loss in the latter case due to eddy currents and hysteresis. Measurements made upon the Ballston line indicate an apparent trolley resistance of 1.3 times the ohmic resistance, and a rail resistance 6.55 times the ohmic resistance.

The resistance of the alternating-current trolley wire is somewhat reduced by the steel catenary in parallel with it. The alternating-current trolley wires are five feet apart and 16.5 feet above track, while the four seventy-five-pound track rails are tied together every 1,500 feet. The increased resistance with alternating current is a serious factor in low voltage alternating-current city systems, but since the compensated motor operates perfectly with the direct current of our city systems, no general necessity exists for a low voltage alternating-current trolley.

The form of alternating-current trolley adopted for the Ballston line is adapted to the requirements of steam roads where the local service is taken care of electrically and through passenger and freight handled by steam locomotives, pending a complete change to electrical operation. The trolley wire and insulators being off-centre are not exposed to the gases of the locomotive exhaust, and a catenary construction placed off-centre can be hung much lower than a standard centre wire without interfering with brakemen on freight cars. A low-running trolley at the side of the car is also preferable in main line operation as it conforms better to the clearance diagram of such roads without calling for too great a change in height of the trolley-wheel or bow. The trolley suspension adopted on the Ballston line therefore affords valuable experience with a form of construction adapted to the requirements of electrically converted steam-operated lines.

The present substation of the Schenectady Railway is temporarily located at Ballston Lake. This substation is operated from the distributing system of the Hudson River Power Company, but owing to the fact that this system operates at forty cycles it became necessary to introduce a frequency-changing device, and an inverted converter operated from the substation direct-current bus-bars afforded the most ready means of obtaining twenty-five-cycle current. The permanent substation will be erected at Ballston and the inverted converter will be replaced by a motor-generator set which will give better regulation than can be obtained from an inverted rotary converter. The substation feeds directly into the trolley circuit at 2,200 volts with no outside transformer substations.

Owing to the fact that twenty-five-cycle three-phase generators are almost universally used to supply rotary converters in existing interurban railway systems, the General Electric Company has adapted both the design of the compensated motor and the alternating-current distributing system to operate from existing twenty-five-cycle generating stations. As the alternating-current motor is single-phase, a single-phase generating and distributing system commends itself on account of its simplicity. The step-down transformers may be tied together on the low-tension side through the trolley with consequent reduction in amount of copper required. Each substation acts as a reserve to the adjacent one and a transformer may be cut out without shutting down a trolley section.

When it is desired to make use of or install a three-phase generator to take care of the operation of rotary converters, induction motors, etc., the preferred arrangement to balance the load at each substation is to install three-phase, two-phase transformers connected two-phase on the secondary side and feeding separate trolley sections from the two phases.

The car equipped with the compensated motors weighs 30.4 tons total without passengers, and is geared for a maximum speed of about forty-three miles per hour on level. The car manufactured by the J. G. Brill Company has a thirty-two foot body, is forty-three feet over all, and a seating capacity of forty-four passengers. The body is mounted upon

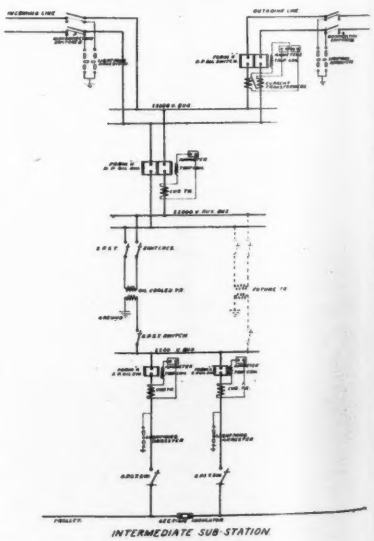


FIG. 4.—SCHEME FOR A SINGLE-PHASE RAILWAY DISTRIBUTING SYSTEM.

Brill No. 27 trucks, having six-foot wheel-base, each truck carrying two compensated motors, each motor equivalent to a fifty-horse-power direct-current motor, standard railway rating.

The compensated motor consists of an annular laminated iron field with a distributed winding similar to that of an induction motor, and an armature provided with a commutator similar in general mechanical construction to a direct-current railway motor armature. These motors are wound for 200 volts, are permanently connected two in series, and are fed from the 400-volt secondary of an eighty-kilowatt, air-blast, step-down transformer carried on the car. The distributed character of the field winding compensates for the armature reaction, so that power-factors are relatively high throughout the range of operation. This type of motor is so designed that at the free-running speed of the car, which is the condition most frequently met with in suburban work, the power-factor and efficiency are nearly at their maximum values.

A set of motor characteristics is shown in accompanying diagrams for both alternating-current and direct-current running. It will be noted that the speed-torque characteristics for alternating-current running are equal to direct-current running in meeting the requirements of railway work. Unlike the multiphase induction motor with its practically constant-speed characteristic, the compensated motor varies its speed with the load and is thus better adapted to operate trains over an irregular profile. The commutation of

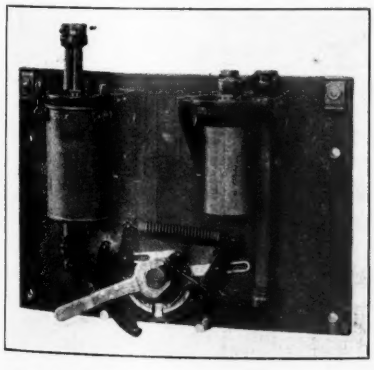


Fig. 8.—Oil Switches for Alternating-Current Traction System.

the compensated motor is equally satisfactory when running alternating current or direct current, and this good commutation is secured by careful electrical and mechanical design without using high-resistance leads.

Our city railway systems have so expanded and cover such a large territory as to make it objectionable, both on the score of first cost and complication, to install a separate alternating-current trolley at reduced potential in order that cars equipped with alternating-current motors may benefit from running over

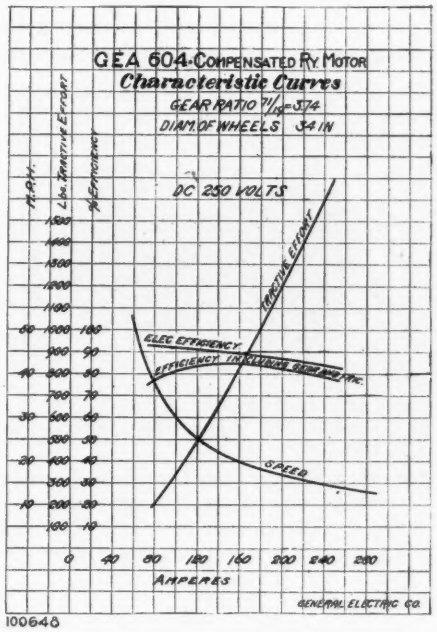


Fig. 5.—Characteristics of Compensated Motor, Direct-Current Running.

city streets at termini and en route. There is a comparatively small additional expense required to adapt alternating-current equipment to run either alternating current or direct current, and in the case of the Ballston line this is accomplished with the use of a standard K-28 direct-current series parallel controller used in connection with a commu-

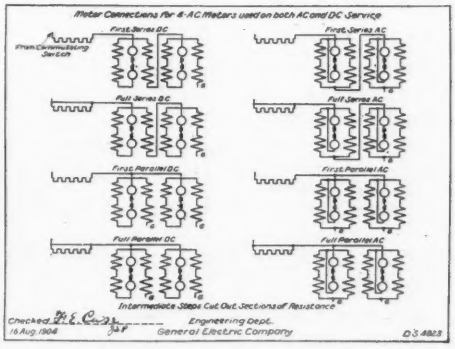


Fig. 7.—Scheme of Connections of Compensated Motor for Direct and Alternating-Current Running.

tating switch to change field connections, cutout step-down transformer, change line fuses, etc. The time required to operate the commutating switch is but a few seconds. The scheme of connections in diagrammatic form is shown in accompanying prints.

The commutating switch is interlocked with two main oil switches, one being in the high-tension alternating-current and the other being in the direct-current circuit, this interlocking being so arranged that only one switch can be closed at a

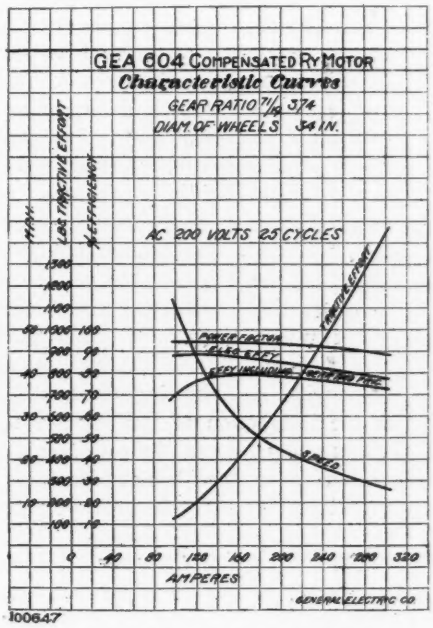


Fig. 6.—Characteristics of Compensated Motor, Alternating-Current Running.

time and the commutating switch can only be thrown when the oil switches are in the off position. Owing to the fact that the alternating-current trolley construction is off-centre, while the standard city and suburban trolleys are directly overhead, it has been necessary to provide double sets of trolleys, one for alternating current and the other for direct current, hence the necessity of interlocking the oil switches and commutating switch to prevent trouble should both trolley poles accidentally be up at the same time. Where centre wire construction is used on both the city and suburban sections, the alternating-current and direct-current trolley wires may be overlapped for a short distance to facilitate changing from one trolley to the other.

With equipments operating with both alternating-current and direct-current power it is preferable to utilize the standard series parallel controller in order to minimize weight of controlling apparatus. Such a method of operation will not give quite so high efficiency when accelerating with alternating current as could be obtained with potential control. This difference, however, is very small due partly to the infrequency of stops occurring upon those sections of the road equipped with alternating-current trolley, but principally due to

the flexible character of the speed-torque curve of the alternating-current motor which gives a high efficiency of acceleration with series parallel control.

With modern suburban cars, especially those equipped with train control, air brakes, air compressors, etc., there is some difficulty in suitably locating the proper apparatus, even when equipped for direct-current running only. With cars equipped for both alternating-current and direct-current running, using series parallel controller, there will be required but slightly more space and weight than for direct-current running only. Should, however, advantage be taken of the slightly better efficiency of alternating-current potential control, such cars must be operated by alternating current upon both suburban and city sections with the resulting disadvantages, or the installation of two separate controlling systems must be considered, necessitating a considerable increase in weight and difficulty in providing room for the necessary apparatus.

The efficiency of the potential control is not over two or three per cent higher than that of the series parallel control, but the use of the latter, permitting operation of both alternating current and direct current, secures the advantage of the higher efficiency of the motors when running direct current over city streets.

For locomotives or other service where no necessity exists for operation over city direct-current systems, the potential method of control may offer advantages sufficiently great to warrant its adoption.

The eighty-kilowatt step-down transformer is air-cooled, forced draught being obtained by motion of the car itself. The transformer is suspended below the car floor, and all primary leading-in wires are carried in brass tubing which is grounded. Car lighting and heating is effected from the direct-current trolley in the standard manner, and from the alternating-current trolley from the secondary of the transformer. Trolley poles and wheels are of standard design,

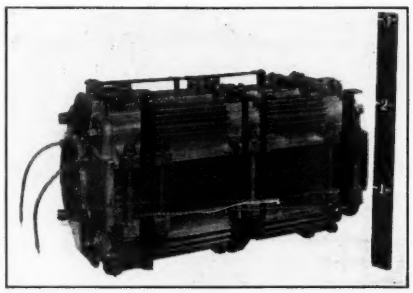


FIG. 9. — SINGLE-PHASE AIR-COOLED TRANSFORMER FOR ALTERNATING-CURRENT CAR EQUIPMENT.

the alternating-current trolley pole being somewhat shorter as this wire is lower than the direct-current trolley. The base of the alternating-current trolley is treated with vacuum compound and further insulated from the car body by composition insulators. The air compressor for the brakes and whistle is operated by a compensated motor which operates from both alternating-current and direct-current circuits.

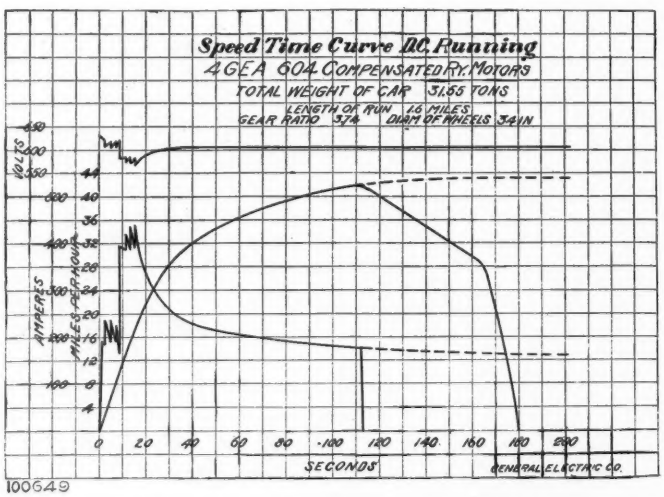
It is instructive to compare the performance of the compensated motor equipment when operated with alternating current and direct current. The accompanying speed-time curves were taken over the same stretch of track with alternating current and repeated with direct current. The direct-current speed-time and ampere-time curves are typical and require no particular comment. The alternating-current run taken under exactly similar conditions over the same track illustrates what can be expected from series parallel control with compensated motors. The rate of acceleration is somewhat lower in the alternating-current run, hence requiring the application of power up to the moment of braking. The shape of the speed-time curve also is characteristic of alternating-current motor work; that is, a comparatively short time on the controller with a large amount of motor curve acceleration. The short period of fractional voltage running of alternating-current motors makes the method of their control of secondary importance and largely minimizes the economy of potential control over series-parallel control.

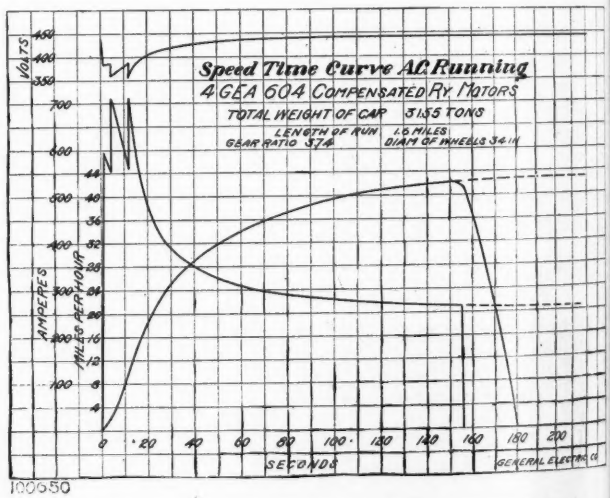
The following constants apply to both sets of runs:

COMPARATIVE ALTERNATING-CURRENT AND DIRECT-CURRENT RUNS.

	Direct Current.	Alternating Current.
Length of runs	1.6 miles.	1.6 miles.
Weight of car	31.55 tons.	31.55 tons.
Time	180 seconds.	180 seconds.
Average current power on	229 amperes.	246 amperes.
Average voltage	606	425
Volt-amperes full speed on level	98	110
Volt-ampere hrs. per ton-mile of given run	86.3	125.5
Average speed	32 m.p.h.	32 m.p.h.
Schedule speed including 15 seconds' stop	29.5	29.5

The low volt-ampere hours per ton-mile of the direct-current run is partly due to the better efficiency and power-factor of the compensated motor when run direct current, and partly due to the somewhat higher rate of acceleration, permitting some coasting and resulting in a more efficient speed-time curve. The difference in volt-amperes alternating current and direct current depends upon the length of a given run and the values approach each other more nearly with a run of greater length. It will be noted that the compensated motors run the car at practically the same speed with 200 volts per motor, alternating current, and 300 volts, direct current. This uniform speed is obtained by series paralleling the fields as shown in diagram of connections attached.





FIGS. 10 AND 11.—CURVES SHOWING PERFORMANCE OF COMPENSATED MOTOR FOR DIRECT-CURRENT AND ALTERNATING-CURRENT RUNNING. CURVES WERE OBTAINED BY THE AUTOMATIC RECORDING INSTRUMENTS DEVELOPED ESPECIALLY FOR RAILWAY WORK.

Tenth Annual Convention of the Ohio Electric Light Association.

Proceedings of an Interesting Meeting Held at Sandusky, Ohio, August 16, 17 and 18, 1904.

THE tenth annual convention of the Ohio Electric Light Association was held at Sandusky, Ohio, on August 16, 17 and 18. Mr. J. H. Perkins, general superintendent of the Youngstown Consolidated Gas and Electric Company, elected last year as vice-president, presided over the sessions, the president, Mr. S. M. Rust, formerly of Piqua plant, but now with the Hobart Electric Manufacturing Company, of Troy, Ohio, having resigned his office of president upon leaving the ranks of active membership. Mr. S. S. C. Ayres, superintendent of the Greenville Electric Light and Power Company, in the absence of Secretary Gaskill, filled his chair.

There was a tripartite interest attendant upon the gathering; first, the intercourse between central station men, for whom the association was primarily organized; second, the opportunity afforded the supply men and manufacturers' representatives for a clearing-house of ideas, and last, and in the minds of some twenty-seven candidates greatest, the ceremonies attendant upon the rejuvenation of the Sons of Jove, the new secret society among electrical men.

The first session of the convention was held at 2 P. M. on Tuesday. The following new members were elected: active, Gallipolis Gas and Electric Company; Mt. Gilead Water, Light, Heat and Power Company; the Cardington Electric Light, Heat and Power Company; the New Lisbon Gas Company; the Delta Electric Light Company; the Crestline Illuminating Company; the Bellevue Light and Power Company.

Messrs. S. M. Rust and W. J. Hanley were appointed sergeants-at-arms, and Mr. C. M. Hart, of the Sandusky Gas and Electric Company, was made generalissimo of the ladies entertainment committee. He was assisted by Mrs. H. B. Warren, chairman, Mrs. W. Beupel and the Misses Bernice Warren and Lenhart.

The president made a plea in the interests of better business records. He suggested several advantages which had come about in his career as the result of systematizing and studying statistics of operation. It was a surprising fact that of twenty-two plants operating in or near to Ohio territory, only two knew how much coal they were burning per kilowatt-hour, and only three had kept a record of their output per day or per month when appealed to for information of this nature.

The first paper read was that by Mr. Lehman B. Hoit, on "A Day Load as a Factor in Central Station Earning Capacity."

The object of Mr. Hoit's paper was the consideration of some of the essentials of electric power transmission from a central station point of view, and to give a partial appreciation of the relation of costs, returns and load-factors that such a station bears to isolated systems for manufacturing purposes.

Mr. Ayres asked if calculations for regulation would agree always with the results of the test in that regard?

Mr. K. C. Randall stated that calculated results will agree more closely with the actual values than test results.

Mr. S. E. Johanneson, of Pittsburg, read a paper entitled "Transformer Testing for Central Stations."

This was a most interesting and valuable paper and in the main gave the various tests which may be applied to transformers. These included preliminary tests, for ratio and polarity; temperature and insulation tests, for determining continuity of service; resistance, impedance and regulation tests, for determining quality of service; and iron loss, copper loss, and efficiency tests for determining economy of operation. The descriptions of these tests were supplemented by diagrams and exhaustive discussions of each circuit.

Mr. P. R. Boole, of the Electric Appliance Company, Chicago, read a paper entitled "Relation of the Supply House to the Central Station."

Mr. Boole sketched briefly the development of the electrical supply houses of the country. Twenty years ago practically the only items carried in stock were underwriters wire, sockets, wood rosettes, wood base cutouts and wood cleats. At the present time it was necessary for a supply house to carry in stock or at least be able to secure immediately about 16,000 different items. He commented upon the training of salesmen for the special work of calling upon central station men and their usefulness in disseminating information.

Mr. H. W. Hillman, of the General Electric Company, Schenectady, N. Y., read his paper on "The Important Relation of Electric Heating Devices to Central Stations."

Mr. Hillman spoke of the great advance in the use of electricity for heating and cooking purposes. This, in his opinion, offers the opportunity for a new activity in central stations. Costs, as given by Mr. Hillman, easily permit competition with gas.

Mr. Perkins thought that in order to ensure their adoption by people generally, cooking apparatus using electrical current must appeal to the pocketbook of the consumer in economy of current; also, that it might be well to devise either a double wiring that would provide for two classes of use, as is the case with fuel and illuminating gas, or some means to offset the disadvantages met with in the cooking for one meal at least being done at the peak load.

Mr. M. E. Turner asked if Mr. Hillman was going to build up such a tremendous heating business, the maximum going on at six o'clock in the morning, or twelve noon, how could then the central station be reasonably expected to give a lower rate at noon than at six o'clock in the evening? He granted that the heating load would earn a lower rate, just as the motor load had earned a lower rate, but in neither case should this be on account of the time of the maximum load, but because of the length of time used. Almost all these devices cross the maximum load on the station, because especially in winter in the cities the maximum starts up on dark days along about half-past two or three o'clock. As the motor and heating loads are built up the load curve will flatten. Users should be charged for their proportion of standing charges, whether their maximum comes at twelve noon or six at night. Some sort of cooking is done almost all day long during the summer months.

Mr. Clohesey seemed rather concerned with the question of the reliability of heating and cooking devices, and the other phases of the matter so far as the distribution of the load would take care of themselves, and also the question of rates for such service.

Mr. Jackson thought that even if found to be safe, the question still remained open as to whether cost would be prohibitive or not, and he urged that careful investigation be had so as to ascertain, if possible, what rate should be charged for such service, and whether it was possible to supply it cheaply enough to justify exploiting the devices. Mr. Turner thought it would be highly inaccurate to infer simply because the average cost of

current might be placed at five cents and sold at seven, eight or ten cents that a reasonable profit would be proved by taking that method of arriving at it.

Mr. Ayres said that in this city, Greenville, they had a system which took care of that question very nicely. There are a large number of costs to the central station that are in no way dependent upon the amount of current produced, but are measured by the size of the station or its capacity to produce a maximum amount. In his city the central station is divided into two general heads. The figures are taken from the books of the secretary, showing actual expenditures for all classes, and analyzed and placed under one or the other of two columns, in one column being placed all costs that do not vary with the amount of daily consumption of current, but vary simply with reference to the size of the station; and in the other column, all costs that vary with the amount of current produced. As a result, after examination and deductions made, it was found that the cost per kilowatt per month of connected load, provided it was turned on at all times, was $3, accordingly consumers are charged $3 per kilowatt per month of connected load, and in addition a charge is made at a uniform rate for hours turned on, which latter charge varies with the amount per month consumed.

The first paper to be read on the second day was by Mr. H. W. Hillman, of the General Electric Company, Schenectady, on "The New Luminous Arc Street System."

Mr. Hillman stated that 300 magnetite lamps had been operating at Jackson, Mich., for a period of three months, and for four months at Portland, Ore., in a most satisfactory manner. He described the equipment of the system, which includes a Brush dynamo, wound for four amperes and 11,250 volts, serving about 135 magnetite lamps, and a new type of combination hanger and cutout. The luminous arc, he said, gave an effective illumination of about thirty per cent greater than the enclosed arc—either series direct or series alternating. Considering the volume of light, the efficiency of the luminous arc system was high. The electrode life of the lamp is 150-175 hours.

In the discussion following Mr. Hillman, in reply to a question from Mr. Bechtel as to whether the saving in trimming justified the sacrifice in light, said that he believed if he were personally operating a plant that he would take the 150-hour electrode and give the city the benefit of the better light; the difference between 150 hours and 500 hours might make a difference of one man only, which estimated at $600 a year would mean on, say, 600 lamps, $1 each, which was unimportant when weighed against considerations of pleasing the people with the light.

Mr. Randall asked in what respects the lighting was best, whether because of intensity, or the color of the light? Mr. Hillman replied because of the intensity and distribution. There are no heat rays in the mercury arc, which can be proven by using the radiometer, but it gives a mild light peculiarly grateful to the eye, and the distribution is after the manner of daylight, of a mild form. But in Harrisburg, Williamsport, Brooklyn, Newton, Schenectady and a dozen different places, the results had been most satisfactory.

Mr. K. C. Randall, of Pittsburg, Pa., followed with his paper, "Notes on Incandescent Street Lighting."

After calling attention to the need of an incandescent system of street lighting where streets are narrow, crooked or heavily shaded, Mr. Randall describes the several systems of regulation which have been developed for series incandescent lighting. Particular attention was directed to the shunt-box system and to the constant-current transformer method. These two systems were then compared, the general conclusions reached being that the shunt-box system is the cheaper for about seventy twenty-five-candle-power lamps or for about 100 fifty-candle-power lamps. The losses of the shunt-box system are lower at small capacities up to twelve kilowatts in twenty-five-candle-power lamps and lower than the regulator system up to twenty kilowatts in using fifty-candle-power lamps. The shunt-box is more flexible for incandescent work, but where arc lighting is also to be done the regulator system is preferable. While the latter system is inferior for small capacities, it is superior for large capacities, depending on the size of the lamp used. The power-factor and efficiency of the regulator at full load are high and falls as the load is reduced, while those of the shunt system remain constant for all loads.

In the discussion Mr. Perkins asked if the series transformers were used could both arcs and incandescents on the same circuit be inserted anywhere in the circuit? Mr. Randall replied in the affirmative, but if the circuit is of any considerable extent it might be better to make a second coil of your regulator good for the incandescent circuit. Additional lightning protection in a long circuit should be provided.

Mr. E. H. Houghton's paper, entitled "Notes on the Incandescent Lamp," was listened to with interest.

The symposium on central station heating which had been arranged, owing to the absence of the participants at this time, was postponed. A few remarks were made by Mr. Houghton in regard to lamp renewals. He had some data from Mr. Van Ness with the McMillan interests, to the effect that with lamps at sixteen cents each, taking 420 hours as their life to smashing point, renewing every seventy days, the cost of lamps per kilowatt-hour is seventy-six cents; cost of renewing per kilowatt-hour, 0.071 cent. A three and one-half-watt lamp, 750 hours to smashing point, twelve per cent days as the period of renewal, cost of lamps per kilowatt-hour is thirty-eight cents; cost of renewing per kilowatt-hour is thirty-six cents. Mr. Wilcox, the writer continued, of the General Electric Company, advocates the use of a lamp even higher in efficiency than three watts per candle; and that a 3.1-watt per candle lamp should, at least, be supplied in central station service. Mr. Van Ness assumes a 3.1-watt lamp to have a life of 420 hours, and a 3.5-watt lamp to have a life of 750 hours. Mr. Whipple asked if Mr. Houghton when selling to a central station man a 3.1-watt lamp, would guarantee him more than from 6,300 to 6,500 candle-hours? Mr. Houghton replied that his company guaranteed 8,500 candle-hours on a 3.1-watt lamp of double-filament type; and 7,500 candle-hours on oval anchor type.

The afternoon session of Wednesday was opened by a paper on "The Steam Turbine and Its Use," by Mr. E. C. Crocker, of the Warren Electric Manufacturing Company, Sandusky, Ohio. Mr. Crocker stated that his company was building 300-kilowatt machines at present, the largest size, and had one in use at its factory in use on testing block; geared to a shafting for testing its belted machines.

The form of turbine devised by Mr. Crocker is built on the principle of expanding steam in a diverging nozzle down to a given pressure, where it impinges on the first set of blades or buckets fastened to a revolving disc. It is then expanded on successive sets of blades until it is delivered to the exhaust in a nearly stationary condition. The speed regulation is such that two per cent is guaranteed.

Mr. Frank Conrad read a paper on

"The Instrument Equipment of a Testing Department." The very fine line of instruments of precision on exhibit by the Westinghouse Electric and Manufacturing Company at this convention was peculiarly appropriate in connection with Mr. Conrad's subject.

Mr. Conrad emphasized the importance of the proper selection of the instrument equipment, and the degree of accuracy required. The adaptability and service of portable instruments were discussed, and the use of both direct-current and alternating-current apparatus detailed. Auxiliary devices were discussed and the author devoted an extensive chapter to an essay on standard instruments.

"Graded Costs of Electric Supply" was the title of a paper read by Mr. M. E. Turner, of the Cleveland Electric Illuminating Company.

Mr. Turner showed in simple form the necessity for a system of graded costs, or rather charges, for electricity supply. He called attention to the disproportion of service capacity and service demanded which had a universal existence. He divided costs into standing and running charges and then gave an illustration of the method, assuming a station of 500-kilowatt capacity, and the units to be sold per year amount to 450,000 kilowatt-hours. It was estimated that there was a standing cost of $80 for each kilowatt of capacity installed, or 21.9 cents per day for each kilowatt of capacity held at the customer's disposal, whether current is generated for that customer for one hour or for twenty-four hours per day; the running cost was 2.11 cents per kilowatt-hour sold, derived by dividing the total running charge per annum by the 450,000 kilowatt-hours sold. Dividing the fixed cost of $80 by 365 days, and adding the running cost of 2.11 cents per kilowatt-hour, it gives the total cost per kilowatt-hour to this supply station for the electricity used any number of hours per day of the kilowatt capacity held at a customer's disposal. This cost varied from 3.02 cents per kilowatt-hour for twenty-four hours per day, to 24.01 cents per kilowatt-hour for one hour per day.

The closing paper of the afternoon was that by Mr. G. Brewer Griffin, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., entitled "Points for Consideration when Purchasing Series Alternating-Current Arc Lamps."

The author treated this subject exhaustively, going into the phenomena of optics and illumination and burning of carbon. Discussing the points to be understood when selecting a series alternating-current arc lamp equipment, he took up in turn the mechanical construction, the mechanism, the electrical performance, the commercial performance, the commercial operation, the comparative advantages, the mechanical construction, the electrical construction and the control panel.

The Thursday morning session closed the convention. At this session a paper was read by Mr. W. E. Richards, of the Toledo Railway and Light Company, on "Unaccounted-for Current." He said that each part of a system should be examined carefully for loss and that the meters should be inspected frequently. Mr. Bechtel stated that at Toledo they had two systems, one alternating current and one direct current, the down-town being entirely direct three-wire design; they account for about ninety-two per cent of that current, and about eighty per cent of the alternating current. Three years ago the loss in the alternating-current district was about sixty per cent; most of the loss had been found in the transformers, due to old and obsolete types of transformers, which have since been changed to modern types of oil coil. The feeder system was gone over to some extent, but had not proved so important an item; the feeder drop did not exceed five per cent, and that upon the peak only. Mr. Bechtel agreed with Mr. Perkins in the latter's statement that the greater part of the unaccounted-for current was in transformers and meters. Changes in transformers made at Youngstown had resulted in cutting down the core losses sixty-six and two-thirds per cent.

The discussion having closed on the paper, President Perkins presented for consideration the following question which had been passed up: "I should like to know of some inexpensive and reliable way of testing a Thomson recording watt-meter without taking it out of service and moving to the testing room or laboratory at the central station." Mr. Turner took the general ground that meter inspections should not be made on premises; if the object was to make a cheap test, the testing could be done at less expense in the testing room than on premises; there was greater percentage of error in testing on the premises, and acceding to every trivial request to test a meter on premises had the effect of destroying confidence in meters, which have now reached such a high degree of accuracy and reliability that they are as accurate or more so than meters for any other form of public service. His experience was that a man at the central station laboratory could test on an average twenty-five meters per day as against eight or ten on premises, and do it much more satisfactorily, including necessary repairs and adjustments. Mr. Gilmartin asked if a commutator meter in process of being transported to place after testing at central station would stay in the same condition that it was after test had been completed at the central station? Mr. Turner thought that with proper men employed in this branch the meter would be handled properly and be subject to no difficulties from jar in moving back to premises.

In the absence of Mr. Gaskill, his paper on "Joint Use of Poles by Public Service Companies" was read by Mr. Perkins, and after a discussion of some of the points contained in it, in executive session, the recommendation to appoint a special committee was concurred in, the committee not being named, however, at this time. After hearing in executive session reports of officers and special committees, the convention went into election of officers, resulting as follows:

President, M. E. Turner, Cleveland, Ohio.

Vice-president, F. E. Valentine, Piqua, Ohio.

Secretary-treasurer, D. L. Gaskill, Greenville, Ohio.

Advisory committee, D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; E. J. Bechtel, Toledo.

Executive committee, J. H. Perkins, Youngstown; C. M. Hart, Sandusky; J. F. Bendure, Lima; M. C. Hull, Columbus; W. E. Miller, Mt. Gilead.

Finance committee, C. E. Inman, Warren; N. Way, Lisbon; W. P. Engle, Defiance.

The president-elect, Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, has been a regular attendant upon the meetings of this association for some years, and has contributed many valuable papers and discussions to its proceedings. His attention has been largely directed to a close study of the details of operating expense and economy, and under his leadership it is expected that this department of the work of the association will receive on its programmes the consideration its importance justly merits. In his speech of acceptance President-elect Turner after thanking the members for the unexpected compliment paid him, adverted to the valuable work done by the retiring president, and by Secretary Gaskill, in whose capable hands most of the detail work of the association must necessarily remain. A special vote of thanks

to ex-President Perkins was adopted, and to Secretary Gaskill, the former on motion of Mr. Valentine, the latter on motion of Mr. McKnight.

On motion also of Mr. McKnight the usual resolutions of thanks were adopted to the following: the Warren Electric Manufacturing Company, the Sandusky Gas and Electric Company, Mr. C. M. Hart, manager, and to the ladies entertainment committee, Mrs. H. B. Warren, Mrs. W. Beupel, Miss Bernice Warren and Miss Lenhart, also to the technical and daily press.

The Warren Electric Manufacturing Company, through its Mr. Muir and others of its force, contributed greatly to the social pleasures of the meeting. A cap of special design was furnished, and on Tuesday evening the Warren company took the convention to Cedar Point and made up a theatre party there.

The ladies entertainment committee escorted the visiting ladies to the Soldiers' Home by trolley, also to Ruggles Grove, where they were guests of the Lake Shore Electric Railway Company.

The Westinghouse company displayed a fine line of instruments of precision and arc lamps. It showed, downstairs in the lobby, a constant-current regulator for alternating-current series lamps and other numerous exhibits.

The Nernst Lamp Company lighted the hotel lobby with its lamp, and showed upstairs its lights under wattmeter test and lighting colors illustrating the approach of the illumination to daylight effects.

The General Electric Company, in the parlor adjoining the convention room, made an elaborate display, showing its new mercury orthochrome lamp which contains a mercury lamp, and six incandescents which furnish the red rays lacking in the plain mercury type; also a new monochrome type mercury tube with holoplane enclosing globe, to secure distribution, and a mill type for lighting factories, draughting rooms, etc., where a steady light is desired and one easy on the eyes. The mercury lamps were run from a mercury rectifier, rectifying 330 volts alternating current to a direct current of 125 volts suitable for running the lamps. The luminous arc received many favorable comments.

The new candy-making machine was shown in this room by Mr. Goodwyn.

The Duncan Electrical Manufacturing Company showed its wattmeter of late design with visual bearings and compensating device.

The Wagner Electric Manufacturing Company, of St. Louis, exhibited its motor, transformer, switchboard type of ammeter and portable ammeter, the latter of new design.

The following were in attendance representing central stations:

Bellevue—G. Cathcart, superintendent Bellevue Light and Power Company.

Bellaire—E. L. Booth, superintendent Bellaire Light and Power Company.

Cleveland—M. E. Turner, J. T. Kermode, Cleveland Illuminating Company.

Columbus—M. C. Hull, Columbus Railways and Light Company.

Defiance—W. P. Engle, People's Gas and Electric Company.

Delaware—E. F. Gwynn, Delaware Electric Light and Power Company.

Delta—C. S. Longnecker, Delta Electric Light Company.

Gallipolis—C. L. Steenbergen, superintendent Gallipolis Gas and Electric Company.

Greenville—S. S. C. Ayres, superintendent Greenville Electric Light and Power Company.

Kenton—Frank Espy, superintendent electrical department, Kenton Gas and Electric Company.

Lima—J. A. Bendure, manager Lima Electric Railway and Light Company.

Lisbon—N. Way, secretary and manager Electric Light Company.

Mt. Gilead—W. E. Miller, manager Water, Light, Heat and Power Company.

Middletown—E. H. McKnight, Middletown Electric Light and Power Company.

Mt. Vernon—W. B. Wilkinson, Mt. Vernon Electric Light and Power Company.

Piqua—F. E. Valentine, Fred. W. C. Bailey.

Sandusky—C. M. Hart, Sandusky Gas and Electric Company; W. M. Lenhart.

Toledo—E. J. Bechtel, John Gilmartin, W. E. Richards, C. N. Jackson.

Warren—C. E. Inman, superintendent Warren Water and Light Company; S. F. Messer.

Washington—G. N. Clapp, Washington Gas and Electric Company, Middletown, Ohio.

Wauseon—W. F. Hubbell, H. H. Williams and Company, Wauseon Electric Light Plant.

Youngstown—J. H. Perkins, general superintendent; E. H. Beil, assistant general superintendent Youngstown Consolidated Gas and Electric Company.

Springfield, Ill.—E. G. Schmidt, general superintendent Electric Light and Power Company and other companies there.

The following representatives of manufacturing and supply houses were in attendance:

Banner Electric Company—N. L. Norris, secretary and general manager, Youngstown, Ohio.

The F. Bissell Company—Frederick Bissell, president, Toledo, Ohio.

Bryan-Marsh Company—E. H. Houghton, general manager, Chicago; F. W. Godfrey, Cincinnati.

Buckeye Electric Company—F. W. Bliss, Cleveland.

Bullock Electric Manufacturing Company—F. C. Colwell, Cincinnati; F. Wharton, Cleveland.

Central Electric Company—Allen S. Pearl, Chicago.

Cleveland Electrical Supply Company—H. H. Cudmore, Cleveland, Ohio.

Crouse-Hinds Company—Nathan Shute, Cincinnati, Ohio.

Doubleday-Hill Electric Company—Elliott Reynolds, Pittsburg, Pa.

Duncan Electric Manufacturing Company—Wm. H. Sinks, La Fayette, Ind.

Electric Appliance Company—Philip Cass, Chicago; Perry R. Boole, Chicago.

Electric Candy Machine Company—T. G. Goodwyn, Nashville, Tenn.

General Electric Company—W. J. Hanley, H. C. Hauck, A. S. Hertz, Cincinnati; H. W. Hillman, F. G. Vaughn, Schenectady; Robert E. Russell.

General Incandescent Arc Light Company—H. B. Coles, manager, Cincinnati, Ohio.

Hobart Electric Manufacturing Company—S. M. Rust, Troy, Ohio.

Louis T. Kaiser, of Thomas Emery's Sons, Cincinnati.

Kuhlman Electric Company, Elkhart, Ind.

W. G. Nagel Electric Company—E. J. Paradis, Toledo, Ohio.

Nernst Lamp Company—E. R. Roberts, Max Harris, Pittsburg, Pa.; J. C. Wright, Cleveland, Ohio; Charles F. Case, Nernst Lamp Company, Detroit, Mich.

New York & Ohio Company—W. D. Packard, secretary-treasurer, Warren, Ohio.

Post-Glover Electric Company—Chas. S. Kuntz, E. L. Van Winkle, Cincinnati.

John A. Roebling's Sons—W. W. Afleck, J. W. Brooks, Cleveland.

Rumsey Electrical Manufacturers' Company—George A. Rumsey, Jr., Philadelphia, Pa.

Sanderson & Porter—Leo. A. Phillips, New York.

Sawyer Man Electric Company—T. H. Bailey Whipple, New York city.

Standard Electric Company—G. C. Kuntz, L. T. Milnor, P. J. Williams, Cincinnati.

Stanley Electric Manufacturing Company—Thomas F. Clohesey, Cincinnati, Ohio.

Stanley Instrument Company—F. J. Alderson, Great Barrington, Mass.

Wagner Electric Manufacturing Company—Dean Emerson, Cincinnati; Clarence E. Delafield, St. Louis, Mo.; L. B. Hoit.

Warren Electric Manufacturing Company—H. B. Warren, chief engineer; Jim Muir, E. C. Crocker, Sandusky, Ohio; F. Warren.

Westinghouse Electric and Manufacturing Company—W. W. Lovell, G. B. Dusinberre, E. W. Word, R. W. Beebe, Cleveland, Ohio; J. W. Schrantz, Cincinnati; Wesley P. Jend, Columbus; R. L. Rathbone, Detroit; G. Brewer Griffin, K. C. Randall, F. Conrad, Pittsburg, Pa.

General Incandescent Arc Light Company—E. E. Schmid, assistant manager, Cleveland, Ohio.

Reviews of Current Engineering and Scientific Literature.

Zone Dynamos and Motors.

A type of dynamo and motor differing somewhat from the usual is here described by Mr. Henry F. Joel. The principal feature consists in the construction of the energizing field coils, so that one coil only is required in place of two or more coils, and in the design of the position of that coil directly over the neutral zone of the armature and close to and either parallel with or cutting at a slight angle the armature coils undergoing commutation. These features are thought to improve considerably the working and the output of the machine, and it is said that machines constructed on this principle are smaller, lighter and more efficient than those of the old type. The contiguity of the field coil immediately over and close to the armature coil undergoing commutation limits, to some extent, the short-circuit current, and in this way improves the conditions of commutation and decreases the heating of the armature. The adjacent field coil forms a closed circuit over the commutating point, and has a transformer choking effect upon the short-circuited armature coil under commutation. This, it is said, increases the sparking limits considerably, and the output of the armature. The arrangement of the field and field coil decreases magnetic leakage, allows the pole arc to be extended, and makes possible the running of the motor in either direction with fixed brushes, without sparking. The type of construction is simple and cheap. Motors of this type, with an output of from one to two horse-power, running at 1,500 revolutions per minute, have a total weight of seventy pounds. Forty-six-horse-power motors, running at 1,400 revolutions per minute, weigh complete 192.5 pounds.—*Abstracted from the Electrical Review* (*London*), *August* 5.

Electric Lighting of Davenport, Tasmania.

Davenport is a small town of about 5,000 inhabitants, situated on the River Mersey in Tasmania, the large island lying about 100 miles south of Australia. Two years ago the town board decided to install an electric supply system for public and domestic lighting and for the supply of power. Direct-current, three-wire, 440 volts of cross outers with accumulators was the system adopted. The equipment consists of a seventy-horse-power Climax boiler which supplies steam to a forty-eight-kilowatt, direct-coupled set, the engine being by Bellis & Morcom, and the generator a four-pole Brush machine. The battery consists of 240 Tudor cells with a balancing and booster set. The four machines are direct-coupled. The boiler feed pump is electrically driven, and the switchboard has been designed with a view to accommodating a second unit, for which there is sufficient space in the building. There was nearly a full load of lamps waiting for the plant before it commenced to run, and after eight months of operation it has been decided to duplicate the machinery at once. All the lighting mains are overhead, and there is nothing particularly novel about the outdoor work, except the method adopted for changing over from arc to incandescent lamps. At the present time there are twenty-nine incandescent street lamps of twenty-five candle-power each, and ten enclosed arc lamps. There are ten more incandescents arranged to take the place of the arc lamps when desired. To accomplish this the ten arc lamps are arranged in series in two sets of five each on two parallel circuits. The incandescent lamps are connected across the circuits. When the arc lamps are running the two circuits are connected in parallel across the two outer mains. By means of a three-pole double-throw switch the circuits can be thrown on the three-wire system, bringing the incandescent lamps into operation. The fuel used is bituminous coal of a fine quality, obtained within a few miles of Davenport.—*Abstracted from the Electrical Engineer* (*London*), *August* 5.

Armature Reaction in Alternators.

In this research Messrs. J. B. Henderson and J. S. Nicholson have endeavored to make a comparison between the theoretical and experimental reaction of a thirty-kilowatt, three-phase alternator. This machine is of a standard type, having rotating field poles, and giving fifty cycles per second at 750 revolutions per minute. The normal electromotive force is 200 volts, and the current per phase winding is eighty-seven amperes. When an alternator is running light, the electromotive force in the armature is produced by that portion of the field flux which cuts the armature windings; hence, if the magnitude and distribution of the field flux and the distribution of the armature winding are known, it is not difficult to determine the electromotive force on open circuit. When the armature winding is supplying a current, the electromotive force at the alternator terminals is produced by a new flux, which is a resultant of all the magnetomotive forces acting; and although these magnetomotive forces may be known, it is difficult to determine the resultant flux which they produce. It is this problem which the authors here attempt to solve. By a consideration of the arrangement of the armature winding, the curves of magnetomotive force are analyzed into a Fourier series, first for a single phase, and then for the three phases together. This given expression shows that the three fundamentals combine to give us a series of sine waves of magnetomotive force moving forward synchronously with the field poles, and therefore stationary over the poles. Similarly, combining the third harmonics gives a magnetomotive force rotating at one-third the synchronous speed in the opposite direction to the rotation of the field poles. The fifth harmonics move at one-fifth synchronous speed, and in the same direction as the field poles, and similarly for the others. Since these harmonics are moving relatively to the field poles, their effect will be more or less annulled by the amortisseurs and the field coils. The fundamental wave which does not move relatively to the field poles is not damped, and therefore produces most of the armature reaction. The case is then considered where the dynamo is working at a zero power-factor, and the load curves are computed. To test these theoretical curves, load characteristics of the machine were determined experimentally for fifty and seventy-five amperes, for lagging and leading currents at zero power-factor. This load was obtained by means of two rotary converters separately excited, and the power necessary to drive the converters was supplied by direct current to the brushes on the commutator. The results of the experiments show very close agreement with the theoretically determined curves.—*Abstracted from the Electrician* (*London*), *August* 5.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New General Electric Type-TD Voltage Regulators for Direct-Current Generators.

The General Electric Company, Schenectady, N. Y., has perfected and placed upon the market an automatic voltage regulator, known as the type-TD, for

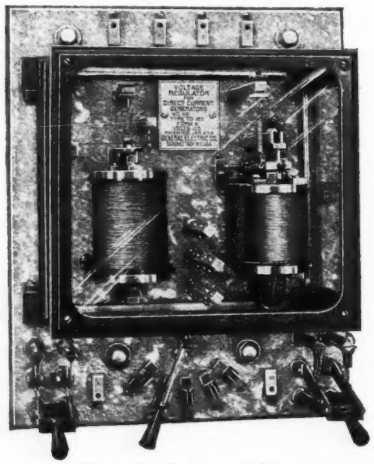


FIG. 1.—TYPE-TD VOLTAGE REGULATOR.

automatic control of the voltage of direct-current generators. The principle upon which this regulator works is that of rapidly opening and closing a shunt circuit across the generator field rheostat. Good voltage regulation ensures uniform candle-power and longer life of incandescent lamps. It reduces lamp renewals and effects a very noticeable saving in cost. If the voltage is maintained at normal both candle-power and life of lamps are 100 per cent, while an increase in voltage of one per cent reduces the life of the lamp eight per cent, and will only increase the candle-power six per cent. Should the voltage be increased six per cent, the life of the lamp would fall thirty per cent, while the candle-power would only be increased forty per cent. Should the conditions be reversed, and the voltage run two per cent below normal, the life of the lamp will be increased fifty-one per cent, while the candle-power will be reduced to eighty-nine per cent. It is therefore essential that the voltage should be maintained as near normal as possible to obtain the best results.

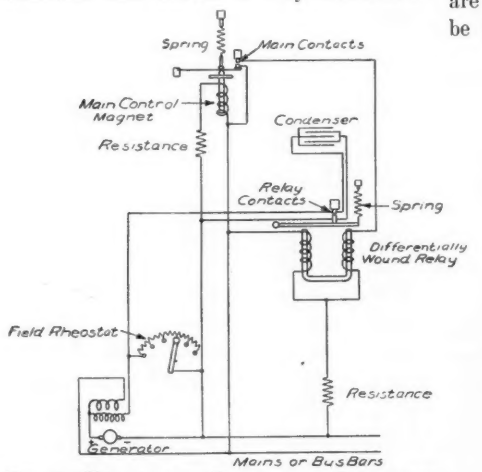


FIG. 2.—ELEMENTARY DIAGRAM OF REGULATOR.

The TD regulators in design and finish are switchboard instruments. They can be furnished in any of the standard finishes, and mounted on white Italian marble or slate bases. A front view of the regulator is shown in Fig. 1.

The operation is as follows: the regulator has a main control magnet and relay. (An elementary diagram is shown in Fig. 2.) The main control magnet takes current from the bus-bars or from potential wires brought back from the centre of distribution and operates the main contacts. The magnet is arranged by means of the spring to just open and close these contacts at the desired voltage. This opening and closing opens and closes one of the differential windings of the relay, thus causing a simultaneous opening and closing of the relay contacts. This throws in and out the field rheostat. To obtain regulation under all conditions of load and speed it will be necessary to turn in sufficient resistance in the field rheostats to lower the voltage about forty per cent below normal, with the regulator cutout. Then when the regulator is thrown out both the main and relay contacts will be closed, thus cutting out the entire resistance from the field circuit, and raising the voltage to normal. Then the main contacts begin to vibrate, and simultaneously the relay contacts, which throw resistance in and out rapidly, and thus maintain a constant voltage. To prevent serious arcing of the relay contacts, condensers are connected in multiple across them.

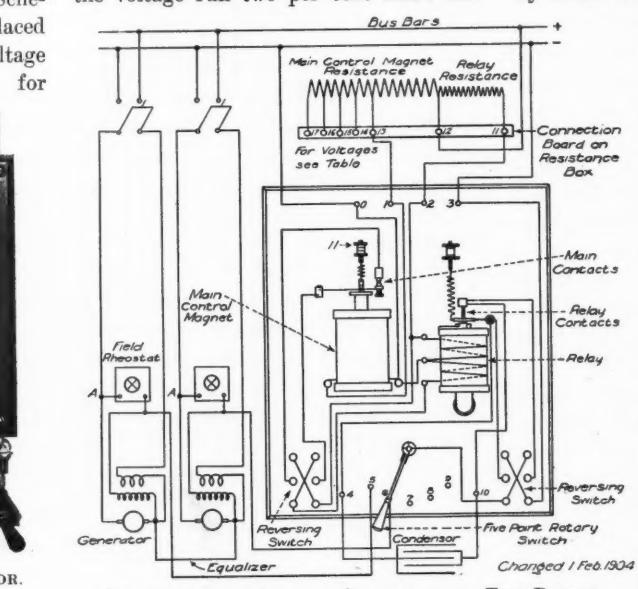


FIG. 3.—CONNECTIONS OF REGULATOR TO TWO DIRECT-CURRENT GENERATORS.

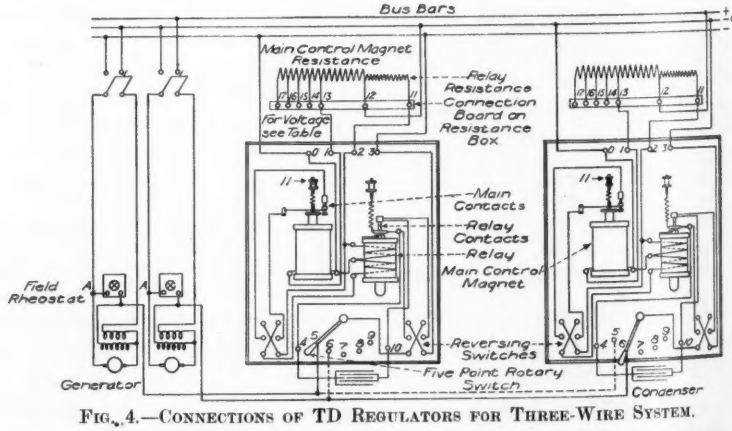


FIG. 4.—CONNECTIONS OF TD REGULATORS FOR THREE-WIRE SYSTEM.

These regulators will regulate shunt or compound-wound generators, but in compound-wound generators the regulator should only be arranged to regulate one generator at a time. All the generators operating in parallel should be connected to the regulator, so that regulation may be obtained from any one of the

generators operating in parallel, or when only one is operating at a time. To do this, each regulator is provided with a five-point rotary switch. Fig. 3 shows the connections of two generators to this rotary switch. It also shows the complete wiring of the regulator to two or more generators operating in parallel. The generator to which the regulator is attached will tend to take the sudden fluctuations of load, but the load will become very quickly equalized between the several generators, due to the series winding. With shunt-wound generators, each generator should be provided with a regulator, as shunt-wound instruments will not trail, due to the absence of the series winding of the generator. In regulating the voltage of a three-wire system using compound generators there should be a regulator supplied on each side of the system, having all the generators connected to both regulators by means of the five-point rotary switch, so that regulation may be obtained from any generator when it is operating on either side of the system. This arrangement is shown in dotted lines in Fig. 4, which gives the full connections of two regulators to a three-wire system. Should shunt-wound generators be used on the system, each generator to be regulated should be provided with a regulator.

The TD regulators are at present designed to regulate machines up to 125-

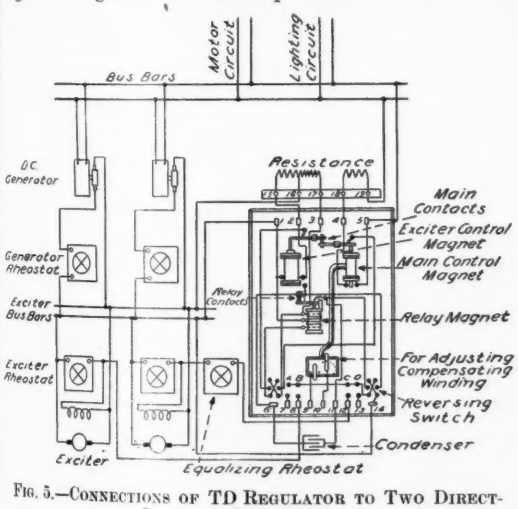


FIG. 5.—CONNECTIONS OF TD REGULATOR TO TWO DIRECT-CURRENT GENERATORS.

kilowatts capacity, and are adapted for the commercial voltages of 125 and 250. If it is desired to regulate generators of a greater capacity than 125 kilowatts, they should be provided with exciters for the excitation of the fields, and the type-TA regulator should then be used instead of the TD. The connections for the TA regulator to direct-current generators are shown in Fig. 5. This shows two generators operating in parallel, excited from two exciters also operating in parallel. With this arrangement any number of generators may be regulated, and these generators may be excited from any number of exciters up to four. If it is not desired to maintain a constant voltage at the bus-bars, wires may be brought back from the centre of distribution and connected to binding-posts 5 and 19, instead of connecting wires from the bus-bars to 5 and 19, and in this way the voltage will be maintained constant at the centre of distribution or at a point in the circuit where the wires were taken off. By separately exciting the fields of the large generators, as above, one regulator will regulate machines of almost any capacity, and accurate regulations will be maintained on one or several generators operating in parallel by this method. The system of exciters applies to both the two and three-wire systems.

A Steam Engine of Exceptional Economy.

In view of the interest at present manifested in the steam economy of prime movers, both of the reciprocating and turbine types, it is worth remarking some results lately obtained in an official pumping engine test at the Park avenue pumping station, Chicago, Ill. The engine is of the Worthington duplex, reciprocating, triple-expansion type, having semi-rotary steam valves, but no flywheel. The latter is replaced by compensating cylinders so arranged that their pistons retard the motion of the main piston during the first part of the stroke, but assist it toward the close, giving a uniform resultant thrust. The pistons of these auxiliary cylinders work against air under pressure from a tank. The engines are vertical and the weight of the pistons, plungers and rods is counterbalanced by another auxiliary balancing plunger, also working through the medium of water against air under pressure.

The capacity of the engine is about 22,000,000 gallons per day against a total head of slightly over 121 feet, and 660.9 horse-power were indicated in the test. The duty obtained was 174,735,801 foot-pounds per 1,000 pounds of steam used, corresponding to an economy of 11.32 pounds of steam per net horse-power delivered in water lifted, or 10.01 pounds of steam per indicated horse-power. The steam pressure was 144.45 pounds per square inch, with 154 degrees Fahrenheit superheat at the throttle, the steam cylinders being provided with jackets and reheaters. Two other engines of the same design in the Central Park avenue station and three more in the Springfield avenue pumping station have all shown under test an economy of steam less than eleven pounds, although the economy per delivered horse-power was not as high in the test quoted. These tests were carried out under the supervision of the bureau of engineering of the city of Chicago and, together with the engines and the power station, are fully described in a pamphlet distributed by Henry R. Worthington, of New York city.

Exhibit of the Electric Controller and Supply Company at the World's Fair.

The striking feature of the exhibit of the Electric Controller and Supply Company, Cleveland, Ohio, at the World's Fair, St. Louis, Mo., section 5, space 28, Palace of Electricity, is the direct motor drive for planers. This drive brings the planer to the same high efficiency as the motor-driven lathe. The motor is geared direct to the cross-shaft and instant change and control of speed is obtainable without changing gears or stopping the planer.

A new system of control specially adapted to mill table motors is shown in operation. This controller makes it impossible to injure the motor by "plugging," and will be of interest to all engineers and mill men.

Several distinct lines of crane controllers are shown. These controllers are specially designed to withstand the rough handling usually the lot of such apparatus in mills and factories. They are all built with the resistance self-contained. All parts are easy of access for inspection, and wearing parts are made renewable.

There are also exhibited a line of knife switches, cast grid resistance banks and solenoids. Magnetic friction and stop-brakes and crane fittings are shown, and a working exhibit of the "Clark" lifting magnet. This magnet is suspended on a Brown Hoisting Machinery Company's tramway hoist and will be of special interest to those who have billets, slabs or plates to handle.

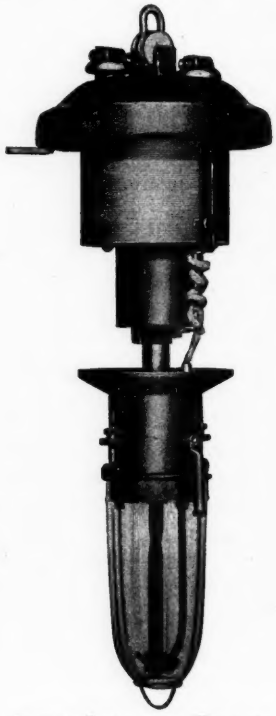
The Automobile Club of America has published a report, giving the details of the service tests of motor wagons and the awards of the contest committee, conducted in New York on April 4 to 9. These reports may be had from S. M. Butler, secretary of the Automobile Club of America, 753 Fifth avenue, New York.

"Climax" Arc Lamps.

The Keystone Electric and Manufacturing Company, Allegheny, Pa., has placed on the market a line of "Climax" arc lamps for both outdoor and indoor service. These lamps are of the direct-current, constant-potential, enclosed type, for 110 and 250 volts.

The manufacturer states that it has produced an indestructible regulating coil. By special machinery a flat copper strip is wound spirally about a solid mica tube, and each layer of the spiral is separated from the adjacent layer by mica washers. The spiral is then surrounded by another mica tube, and the whole is encased in a metal tube with metal heads, to which are fastened the necessary terminals and a clamping device to adjust the coil with, the whole forming a solid, indestructible, fireproof coil.

Climax Lamp for Indoor Service.



Climax Lamp with Housing Removed.

The lamp is also equipped with a flat spirally-wound connector which has great flexibility and durability. The upper carbon-holder and carbon-carrving tube have but one motion and can not be turned. Any possibility of disarranging the flat spiral conductor during operation is thus avoided.

Use is made of a loose-fitting piston of large diameter in the gas-diffusing chamber. This piston is fastened to the clutch plate in such a manner as to have a lateral motion, permitting it to find its own free path, and avoiding all possibility of wear and sticking due to friction.

The enclosing globe cap forms the bottom of the gas-diffusing chamber and dashpot, and carries the indestructible insulating bushing and negative carbon support. This is held in place by two outwardly swinging arms, which are engaged by two lugs on opposite sides of the gas-diffusing chamber and securely fastened with thumb nuts.

The clutch is composed of two cast-iron parts, duplicates of each other, hung on two cotter pins in such a manner that when they fall toward each other the opening becomes less than the diameter of the carbon; hence, when the clutch plate is raised, they grip the carbon securely.

Special attention has been given to the porcelain resistance holder, which has a thread moulded on its outer surface, in which the wire is carefully wound. A special clamping device is placed to one side with a sliding member, by which the adjustment for proper arc voltage is achieved.

If desired, the lamps may be furnished with an external resistance in a separate case for 220 to 250-volt lamps. A switch is provided in the top of the lamp to cut it out of circuit when burning.

The housing is of colonial design, and is made of copper and is riveted, no solder being used on any part of the lamp. The outside globe-holder is fitted to an external sleeve of the main shell by three bayonet locks. Housings of steel or brass can be furnished if desired.

The World's Fair Exhibit of the National Electric Company.

The National Electric Company, Milwaukee, Wis., manufacturer of the Christensen air brakes and electrical machinery, is turning out some large direct and alternating-current generators for lighting, power and railway service. The unit illustrated herewith is of 1,500-kilowatt capacity, and is installed at block 46, Machinery Building, Louisiana Purchase Exposition, and direct-connected to a 2,250-horse-power, vertical, cross-compound engine. The rated output is 1,500 kilowatts, twenty-five cycles, 6,600 volts, running at eighty-three revolutions per minute. The power generated is used for operating the large pumps, the immense streams from which flow over the cascades.

Like all standard alternators built by the National Electric Company, it is of the revolving field type, leaving the armature stationary and easily accessible; the difficulty of properly insulating the armature coils is eliminated as the windings are not subject to any mechanical strains. The revolving field is of large diameter, giving additional flywheel effect to the engine and the construction of the field coils makes them practically indestructible. All parts are accessible and the method of ventilation ensures low temperatures.

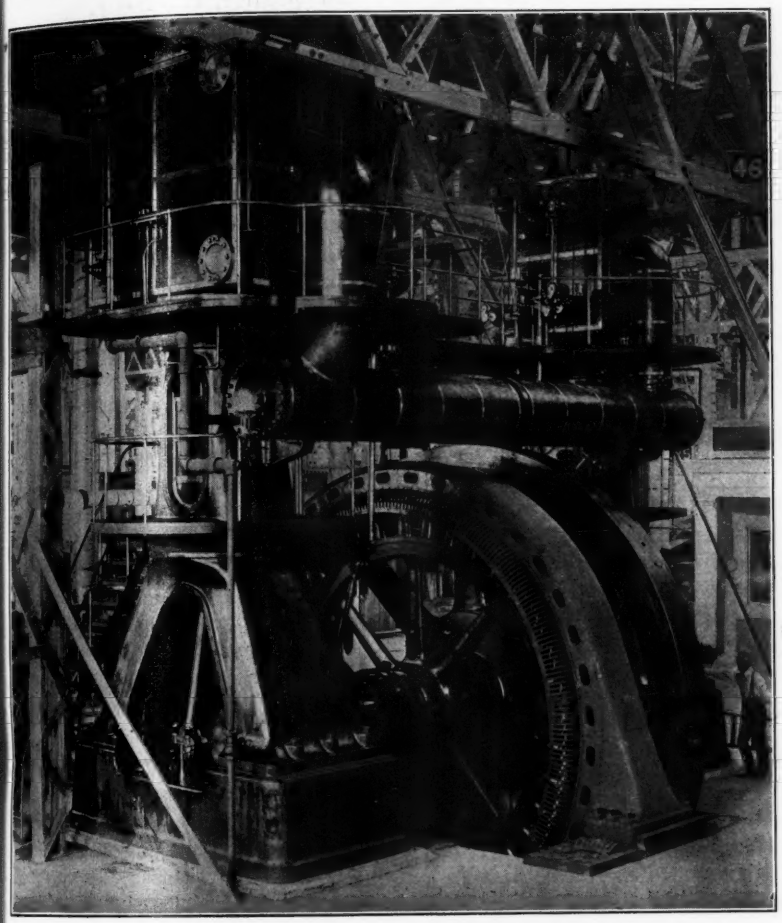
The revolving field is made of cast steel in halves; these are bolted and secured together by shrunk links. The rim of the wheel is in channel cross-section to which the cast-steel pole-pieces are bolted. The field coils comprise sixty-five turns of one and one-half by one-eighth-inch copper strap, wound on edge and thoroughly insulated, the outer edge of the coil being exposed to the atmosphere for cooling. Laminated pole-shoes are secured to the ends of the pole-pieces and serve to hold the field coils in position. These shoes cover a large polar arc, distributing the magnetic flux evenly.

The field coils are insulated from the pole-pieces by fuller board and the pole-shoes and spider rings by heavy fibre. The diameter of the revolving field is sixteen feet and weighs approximately 50,000 pounds.

The frame is a circular cast-iron housing into which laminated punchings with inwardly projecting teeth are assembled for the reception of the armature windings. The frame is exceedingly heavy and stiff, not requiring any external support and is divided horizontally, the halves being firmly bolted and keyed together. Bolts and keys are contained entirely with-

the cross-section, obviating the use of side lugs.

Large open spaces are provided in the sides of the frames, allowing a free pas-



The Exhibit of the National Electric Company at the World's Fair, St. Louis, Mo.

sage of air from the ventilating ducts in the core.

The armature core is built up of laminated soft steel punchings, being annealed and japanned before assembling; ventilating space blocks are inserted at suitable intervals, providing openings extending around the circumference and allowing a free passage for the heat generated in the windings. There are six slots per pole, two and one-half inches deep by one and one-half inches wide, each being wound with fourteen conductors of 0.37 by 0.28 inch compressed copper. The internal diameter of the armature is sixteen feet three-quarters inch and the width of the core sixteen feet.

Cast-iron collector rings and carbon brushes are used, enabling the machine to be operated with the minimum amount of attention and at the same time provides a collector gear which will carry a heavy temporary overload. The net weight of this alternator is 135,000 pounds, and following are the guarantees the National Electric Company offers on this machine.

Efficiency at Power-Factor—One and one-quarter load, 95.5; full load, 95.5; one-half load, 94.75.

Regulation—5.5 per cent on power-factor 1; 22 per cent on power-factor 0. Short-circuit current with full load excitation, 450 amperes. Exciting current at full load, 80 per cent. Power-factor, 240 amperes at 100 volts.

This alternator is excited with a forty-five-kilowatt motor-generator set, the motor side run off 220-volt lighting mains, the exciter current on the alternating being regulated by a rheostat in the shunt of the exciter.

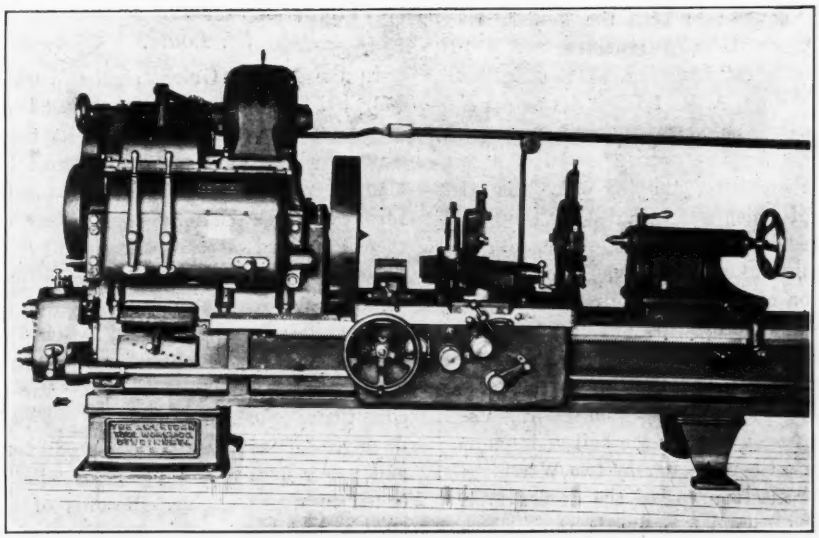
On Friday, July 15, the pit was flooded with water, but the machine was dried out and in operation on the following Monday. This exciter has been short-circuited several times due to short-circuit on the switchboard and mains, but has not been disabled in any way.

The temperature rise does not exceed thirty degrees on armature and magnets on a continuous run at full load and forty degrees on the armature and magnets on a continuous run at twenty-five per cent overload.

The National Electric Company also has an extensive exhibit in the Electricity Building, showing the Christensen air-brake equipments and electrical machinery in operation.

Variable-Speed Motor-Driven Lathes.

The American Tool Works Company, Cincinnati, Ohio, has produced a thirty-inch American engine lathe equipped with an unusually interesting method of motor drive. This machine is shown in the accompanying illustration. The interesting feature of this drive is that a constant-speed motor is employed. In this instance either direct or alternating current may be used, and the various spindle



Variable-Speed Motor-Driven Lathe.

speeds are obtained mechanically through the all-geared headstock. This consists essentially of a patented clutch and gear mechanism which employs a minimum amount of gears and shafts, and is, at the same time, simple and efficient. Through the manipulation of levers 1 and 2, shown at the front of the head, and 3, shown at the lower right-hand corner of the head, sixteen distinct and positive speeds to the spindle are provided in geometrical progression, ranging from 3.8 to 246. A wide range is thus obtained entirely through mechanical means, sufficient to cover the ordinary work of this lathe. By reason of the simplicity of construction, all gears and shafts can be made of large diameter. The whole is encased and all parts are readily accessible for lubrication.

A non-reversible constant-speed motor may be used if desired, because the reversing is obtained mechanically by means of the rod shown mounted above the lathe out of the way, and at the same time in a convenient position for the operator. The advantage of this construction is that the motor is at no time reversed, but runs at continuous, constant speed, all starting, stopping and reversing of the machine being accomplished without interference with the motor.

The motor is substantially mounted above the all-geared headstock, and the lathe may at any time be converted into a belt-driven machine by replacing the motor with a pulley mounted on the upper shaft.

Model Irrigation Plant.

In connection with the Louisiana exhibit of the rice industry, block 101, Agricultural Building, at the St. Louis Exposition, A. M. Lockett & Company, of New Orleans, have furnished the commissioners for Louisiana a model of a complete irrigation pumping plant, the original of which was installed for the Southwestern Rice and Canal Company, near Jennings, La. This model shows a Worthington conoidal pump direct-connected to a compound condensing engine, the steam being furnished by a duplicate set of water-tube boilers, and the exhaust being condensed by a Worthington jet condenser. The feed water for the boilers is pumped from an open heater by two Worthington boiler feed pumps of the duplex type.

The conoidal pump is especially designed for pumping large volumes against low heads. In general appearance, it is somewhat different from the ordinary centrifugal pump, due partially to the widening of the pump chamber to admit a special form of impeller. The latter consists of a double, cone-shaped core on which radial vanes are mounted. The shape of this core serves to modify gradually the direction of the incoming currents of water, thereby preventing sudden changes of velocity and direction which would absorb and waste power. The pump-chamber, or shell, is divided into two equal parts by a radial diaphragm or partition extending entirely around the interior of the chamber and enclosing the base of the conoidal impeller. This partition prevents the impingement and consequent disturbance of the two entering columns of water. The conoidal pump is especially adapted to belt or electric motor driving. The space required in relation to the quantity of water delivered is about one-half of that needed by an ordinary centrifugal pump. The original of the pump shown in this exhibit was designed to deliver 30,000 gallons per minute against a twenty-foot head, and pumps of this type can be used for heads up to thirty feet.

The jet condensing apparatus in this exhibit is of interest as showing a good form of condenser to be used where a natural supply of fresh water is to be had. The exhaust steam from the condenser pump is used in heating the feed water and thus returns to the boiler practically all the heat of the steam, so that the operation of the condenser outfit costs very little, while it adds considerably to the economy of the plant.

The Government's Coal-Testing and Timber-Preserving Plants at St. Louis.

In the Mining Gulch, at the World's Fair, St. Louis, Mo., there have just been completed two exhibits, the results from which will be watched with interest by manufacturers and railroad people throughout the United States. One of these exhibits is a coal-testing plant conducted by the United States Geological Survey. At this plant the fuel values of every grade of coal submitted will be determined. Samples of coal will be analyzed, burned under boilers under varied conditions, coked, and used for gas producing. The values for gas production and power qualities of the gases will be tested in a gas engine. Records of all tests will be kept, and it is believed that the data secured will be of value in the development of new coal fields in this country.

At the other exhibit, the timber-preserving plant, under the direction of Dr. H. Van Schrenk, of St. Louis, tests of all the various methods of preserving railroad ties will be made. The system, briefly, is to dry the wood of all the sap and moisture, and then to exhaust the retort in which it is contained; then while the pores are still open and free from vapor or moisture, to run the preservative mixture into the retort. Under these conditions the pores of the wood are completely filled with the preserving solution. All ties treated at this plant will be put into regular service under some track, and a record kept of each one. The shortage of available timber for railroad ties will make the discovery of a good method of preservation very valuable to railroads.

The machinery for both the coal-testing and timber-preserving plants is furnished to the government free of charge by the Allis-Chalmers Company, Milwaukee, Wis.

In Favor of the Calculagraph Company.

In the Circuit Court of the United States, District of Massachusetts, an opinion was filed by Judge Hale on August 16 in the suit of the Calculagraph Company against John C. Wilson, doing business as the Automatic Time Stamp Company, of Boston, for infringement of two patents, numbered 424,291 and 583,380, owned by the Calculagraph Company, in the manufacture and sale by the defendant of the machine styled the "Timometer." The decision holds that the two patents in the suit are valid, and that claims of both have been infringed by the defendant in his machine. A decree is entered for the complainant for a permanent injunction and for an accounting with costs.

The Philippine Exposition at the World's Fair.

A very good idea of the extent and scope of the Philippine exposition at the World's Fair is got from the brochure issued by the department of publicity. This exhibit is an exposition in itself, covering an area of forty-seven acres and being composed if 1,200 natives of forty different tribes, housed in 130 buildings. Great credit is due the Philippine government board for the completeness of the exhibit. It is probably the first time in the history of the world that so much has been accomplished under such conditions in so short a time. Mr. Herbert S. Stone, chief of the department of publicity, is responsible for the popularity of this exhibit.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LONG-DISTANCE ELECTRIC RAILWAY FROM CHICAGO—Walter C. Nelson, president of the Northern Traction Company, of Indiana, has filed a mortgage of $3,500,000 to the Knickerbocker Trust Company, of New York, and Benjamin L. Allen, New York, co-trustee. The mortgage covers a proposed electric car line from South Bend, Ind., to Chicago, through New Carlisle, Laporte, Valparaiso and Hammond.

ELECTRIC POWER COMPANY REORGANIZED—A certificate of reorganization of the Potomac Electric Power Company has been filed with the recorder of deeds at Washington, D. C. The certificate states that the name and objects of the company shall remain, but the term of the company's existence is made perpetual. The capitalization is to continue at $5,000,000, divided into 50,000 shares. Nine trustees are named to manage the company for the next year: George Truesdell, S. L. Shober, Jr., George H. Harries, James B. Lackey, W. F. Ham, George W. Young, Allan L. McDermott, H. W. Fuller and R. T. W. Duke, Jr.

NEW YORK INDEPENDENT TELEPHONES—It is announced that a movement is under way on the part of the independent telephone promoters to incorporate all of the independent telephone companies in central New York under the name of the New York Independent Telephone Company. Besides the Utica Home Telephone Company the more prominent ones which would become a part of the system are the Rome Home Telephone Company, the Herkimer County Telephone Company, the Interstate company, of Little Falls, the Otsego, Clinton, Oneonta and Cooperstown companies and many of the smaller exchanges operating in the northern part of the state. In time the Syracuse, Rochester, Buffalo and Albany telephone companies will become part of the system.

AN INTEROCEAN TELEPHONE—The Huntington syndicate of California, which a few months ago acquired several hundred miles of long-distance telephone lines in Texas, is said to be carrying out its plans for a through long-distance telephone line between the Atlantic seaboard and the Pacific coast. The southern route will be followed. The acquired lines in Louisiana and Texas and the existing lines in California leave a gap of 600 miles in Texas between San Antonio and El Paso and all of New Mexico and Arizona to be filled in. The syndicate is closing negotiations for the purchase of independent long-distance lines through Arizona and New Mexico, and when this is done about 800 miles of wire will have to be put up for a through connection between Los Angeles and New Orleans. Connecting lines will be built northward all along the main system.

MANILA, P. I., ELECTRICAL ENTERPRISE—The Manila Electric Railway and Light Company, which is hastening to completion with American material an extensive system of electric traction in Manila, P. I., has just acquired the interest of La Electricista Compania Anomima, which Spanish capitalized concern operates the only lighting system in Manila. The franchise acquired is good until 1917, after which time it will be extended for a period of ten years if the bid is the lowest. The Manila Electric Railway and Light Company is controlled by American capital; James F. Swift, of Detroit, Mich., is president of the company. The street railway system is being built by J. G. White & Company, New York. It is understood to have not yet been decided whether the existing plant will be used or power will be derived from the central station now under construction by the new interests.

A NEW INTERSTATE TROLLEY LINE—The trolley road between Central Village and Norwich, it is announced, will be constructed shortly, supplying the missing link, an unbroken electric connection, between Worcester, Mass., and New London, a distance of sixty miles. The line will be built by the Consolidated Railway Company, owned by the steam road. On account of the rough country through which the road will pass the cost will be quite great, amounting to $400,000. Work will probably be begun next spring. A feature of the new road will be its use of the steam road's tracks from Plainfield to Lisbon Station. The former point will be reached from Central Village by a new track parallel to the steam tracks on the west side. Leaving the steam tracks at Lisbon the trolley will pass through Jewett City and Versailles, where it will connect with the Norwich road. Steam traffic from Plainfield to Lisbon will be confined to freight service and the steam trains will run into Jewett City on new tracks to be laid. By the new arrangements Jewett City will secure steam connections as well as trolley. Packerville and South Canterbury will be on the trolley.

THE SUSQUEHANNA RIVER POWER DEVELOPMENT—The plan to develop the power of the falls of the Susquehanna river and electrically transmit it to Baltimore and other cities has been taken up again. The Susquehanna Power Company is the corporation which now undertakes this project. It is said to be backed by Baltimore, Philadelphia, Wilmington and Pittsburg capitalists. The company will be capitalized at $8,500,000, and plans the construction of works to furnish 50,000 horse-power. Its capitalization is to consist of $6,000,000 of bonds and $2,500,000 of stock. The plans of the company are now in the hands of a stockholders' committee of which Mr. James H. Harlow is chairman. Mr. Harlow is also chief engineer of the company, and has been the expert for the projectors of the Susquehanna development for some years. It is estimated that the company can complete a plant of 6,000 horse-power to handle the city contract in six months' time. Such a plant, it is estimated, can be built for $1,000,000, and will become a part of the general development, which is to reach 50,000 horse-power. The present intention of those interested is to supply Wilmington, Del., with power as early as possible. It is expected that Baltimore will take 15,000 horse-power for manufacturing and other purposes. Mr. Harlow, who will supervise the construction, has been engaged for several months past getting ready to begin work.

A NEW MEXICAN ELECTRICAL LINE—An American company is about to construct and operate an extensive electric traction system in and around Monterey, Mexico. The initial lines will entail an expenditure not far short of $2,000,000. Edward F. Walker, of Philadelphia, has concluded negotiations in Monterey for the acquisition of the existing horse car lines and the Mackin & Dillon concession. He closed the deal on behalf of the Monterey Electric Street Railway, Light and Power Company, which was incorporated under the laws of the state of New Jersey for the purpose of carrying out the enterprise. The incorporators were Edward F. Walker, William T. Wheeler and T. A. Beckett. The Ferrocarriles Urbano de Monterey "Empresa Mexicao," usually referred to as the Empresa line, has been purchased by the new company. The system is fourteen miles in length and was largely controlled by Francisco Belden, the Monterey manager of the Bank of London & Mexico. The Ferrocarriles de Monterey y Topo-Chico, commonly known as the Slayden line, of which S. W. Slayden, of T. B. Slayden & Company, 50 Broadway, New York, is the president, has also been bought by the Monterey Electric Street Railway, Light and Power Company. The line is fifteen miles long. It runs from Monterey to Topo-Chico Springs. Included in the purchase of the Slayden system is a long lease of the parks, pavilion and baths at Topo-Chico. A large hotel will be built, new bath houses are to be constructed and large pavilions will be erected by the new interests. The company has taken over the concessions granted by the Monterey authorities to the American contracting firm of Mackin & Dillon, of Monterey. This franchise permits of the construction of some fifteen miles of electric line in the city proper, and from there to one of the principal residential suburbs. The acquisition of the three properties has involved an expenditure of about $500,000 gold. The new company will commence the work of electrically converting the Empresa and Slayden lines and the building of the Mackin & Dillon system within the next sixty days.

ELECTRIC LIGHTING.

WEST POINT, IOWA—The town has voted to install an electric light plant.

YORK, PA.—Work has begun on Lewistown's new heat, light and power plant, which is also to furnish light to adjacent towns.

OWENSBORO, KY.—The report of the superintendent of the municipal light plant for the six months ending June 30, 1904, shows a net income of $1,687.34.

LOGANSPORT, IND.—The construction of an electric power plant, costing $150,000, has been undertaken in this city by Dennis Uhl. The plant will be operated by water power.

PONTIAC, MICH.—At a council meeting the public lighting contract was awarded to Jules G. Hoffman, of Detroit, whose bid of $57.30 per year per light was the lowest presented.

ALEXANDRIA, IND.—The city council has closed a ten-year contract with the Alexandria Electric Light and Power Company for street lighting. The plant has been bonded for $40,000 to Cincinnati capitalists.

QUINCY, MASS.—A stockholders' meeting of the Quincy Electric Light and Power Company was held recently, when the following directors were elected: W. G. A. Pattee, John Cashman, Henry M. Faxon, Henry E. Hardwick, Thomas Fenno. Henry M. Faxon was elected treasurer and Walter M. Packard clerk.

HARTFORD, CT.—The directors of the Hartford Electric Light Company have voted to recommend to the stockholders the issuing of $200,000 additional stock to provide funds for the improvements to be made on the property at Dutch Point, which the company has recently purchased. The present capitalization is $1,400,000.

NEWBERRY, S. C.—The commissioners of public works of Newberry have purchased from the General Electric Company the machinery for the new electric lighting plant. Two new dynamos and sixty-five street lamps will be installed. The system now in use is inadequate to supply the city's demands, and with the present arrangement there is no way of increasing the capacity.

RICHMOND, IND.—The city council has declined a proposition by the Richmond Light, Heat and Power Company to illuminate the city streets at $60 a light a year, and orders the light commissioners to begin lighting the streets from power furnished by the municipal plant on and after September 1.

NORTH ABINGTON, MASS.—The annual meeting of the Electric Light and Power Company, of Abington and Rockland, was held July 27. These officers were elected for the year: president, Lewis A. Crossett; clerk, George W. Kelley; treasurer, Ronald MacDonald; directors, M. N. Arnold, Lewis A. Crossett, Joseph L. Greenwood, George A. Beal, Lot Phillips, George W. Kelley, E. P. Torrey, John J. Spence and Jeremiah Richmond.

WILKESBARRE, PA.—At the annual stockholders' meeting of the American Electric Light Company and the American Gas Company, held in this city, the following officers were elected: president, E. B. Tustin, of Bloomsburg; secretary, Grant Pelton, of Scranton; treasurer and general manager, A. W. Duy; directors, J. B. Russell, of Wilkesbarre; Grant Pelton, of Scranton; J. R. Schuyler, John G. Harman, H. B. Clark, J. G. Wells and E. B. Tustin, of Bloomsburg.

POTTSVILLE, PA.—The Philadelphia & Reading Coal and Iron Company has commenced the use of electricity in some of its mines to supplant steam, and the Alaska colliery is hereafter to be operated electrically. All the machinery except the hoisting engine at the main slope and the cable and scraper line will be run by electricity. This method is much cheaper and will do away with 94,000 feet of steam pipe. The work of installing the plant will commence soon.

AMERICAN FORK, UTAH—The Utah County Light and Power Company, of this place, is considering a proposition to light Salt Lake City with power from American Fork canyon. In the event of the company deciding to do this, it is intended to erect a plant of about 1,000-horse-power capacity one and one-half miles above its present plant. The company has in operation at the present time two 6,600-volt generators, supplying light to American Fork, Lehi and Pleasant Grove, and also furnishing power for the pumps at the mouth of the Jordan river.

COLUMBUS, OHIO—The report of the board of public service on the advancement of the work upon the municipal electric light plant, recently submitted in compliance with request of council, stated that there had been actually expended upon the plant to date $181,830.51 of an available amount of $447,000. The total amount contracted at present is $336,319.40; the amount of available balance, $110,680.60. The report said that the greatest mistake was the failure to secure the services of a competent designing engineer at the outset. It had been necessary to make changes through imperfect plans, and various strikes of workmen had retarded the work. It was being pushed with all possible speed at present.

LEGAL NOTES.

MARCONI WIRELESS VICTORIOUS—In the suit of Henry Gardner against the Marconi Wireless Telegraph Company, of America, Justice Bischoff, in the Supreme Court, denied the application of Mr. Gardner's attorney to permit the Greater New York Security Company to come in as a party plaintiff in the suit.

RECEIVER ORDERED FOR TELEPHONE COMPANY—The application for a receiver for the Commercial Telephone Company, operating the independent long-distance system in southeast and central Texas, has been granted. The Territorial Loan and Trust Company, of Muskogee, I. T., made the application, alleging that interest due January 1 and July 1 is unpaid and that by the terms of the mortgage the entire debt matures upon failure of payment of the interest. The amount due is $427,000.

THE RIGHT OF EMINENT DOMAIN—In the petition of the Hudson River Power Company to condemn land in the town of Colonie, referee decided that the company was not entitled to the right of "eminent domain" in crossing a strip of private land to deliver power on a municipal contract. The referee in rendering his judgment decided that the statute of 1896 does not give the company the right of condemnation claimed, but says that the law can only be construed as meaning in any town or village "where the contract exists and not a right of way leading up to the place the company has the contract with."

PERSONAL MENTION.

MR. S. J. HENDY, of the Joshua Hendy Machine Works, San Francisco, Cal., is touring the East in a business trip.

SIR WILLIAM C. VAN HORNE, of Montreal, Quebec, a director of the Postal Telegraph-Cable Company, has been elected a director of the International Banking Corporation.

MR. CALVIN WINSOR RICE was married on Saturday, August 6, at Winchester, Mass., to Miss Ellen Moseley Weibezahn, daughter of Mr. and Mrs. William Edward Weibezahn.

PROFESSOR HENRY F. OSBORN, of Columbia University, New York city, was awarded the honorary degree of doctor of sciences by the University of Cambridge, on August 22, at Cambridge, England.

MR. GUY P. FELTON, superintendent for the past three years of the Moultrie, Ga., electric light plant, has resigned to accept a similar appointment at Blakely, Ga. He will be succeeded by Mr. M. A. Barr, of Columbus.

MR. WILLIAM H. LINCOLN, for over five years manager of the Grand Rapids, Wis., exchange of the Michigan and Michigan State Telephone companies, has resigned, the resignation to take effect at the convenience of the companies.

MR. JOHN CAMPBELL, electrical expert, has been appointed to represent the city of Kingston, Ont., in arbitration proceedings between the city and the electric light company for the valuation of the latter's plant, preparatory to its being taken over by the municipality.

MR. JAMES W. LYONS has announced his resignation as manager of the power department of the Allis-Chalmers Company. This resignation took effect on August 13. Mr. Lyons has accepted the appointment as consulting engineer to the Elgin Watch Com-

pany, of Elgin, Ill. The company will erect an extensive works under his supervision. Mr. Lyons will also engage in other consulting work, and his headquarters will be at Chicago, Ill. He takes with him the good wishes of all his former associates in the Allis-Chalmers Company.

MR. JOHN TAIT, manager at Winnipeg, Manitoba, of the Canadian Pacific Railroad Company's telegraphs, has been promoted to the assistant superintendency of the central and western divisions with headquarters at Winnipeg. Mr. J. W. Baker, wire chief, succeeds him in the management.

MR. LEWIS J. MAXWELL, who has for some time been assistant manager of the Western Union Telegraph headquarters at Jacksonville, Fla., has been appointed manager of the Western Union Telegraph headquarters at Richmond, Va., for the territory from Charlotte, N. C., to Cincinnati, Ohio.

MR. FRANK J. SPRAGUE, inventor of the Sprague multiple unit system of control, has been awarded the Elliott Cressons medal by the Franklin Institute, Philadelphia, in consideration of the important advance which his inventions have made in the operation of railroads by means of electricity.

HERR SCHULTZ, under secretary of state in the ministry of public works, at the head of a party of German engineers, arrived in New York on August 16. This party will study municipal engineering and building problems. The first city visited will be St. Louis, after which the principal American cities will be visited in turn.

MR. CHARLES F. GOODRICH, general superintendent of the Fox River (Wis.) Electric Railway and Power Company, since January, 1898, and secretary and treasurer of the Knox Construction Company, will end his connection with both companies on September 1. Mr. George W. Knox, president of the Knox Construction Company, will assume the general supervision of both companies.

MR. J. W. TILKYSON, who has been district manager of the San Joaquin Valley Telephone system, has been appointed division superintendent of the new Fresno, Cal., headquarters. J. P. Noble will continue in charge of the Fresno district as manager. The new division includes the four districts of Fresno, Stockton, Visalia and Bakersfield. Heretofore the valley has been included in the division with the country south of Tehachapi.

MR. JAMES MITCHELL, of Lynn, Mass., formerly of the old Thomson-Houston Company and later manager of the Sao Paulo Light and Power Company, has taken charge of the work in connection with transmitting power from the falls of Sapucain to Rio (Brazil), a distance of seventy-five miles, for the Rio de Janeiro Tramway, Light and Power Company, which has lately been incorporated in Canada with a capital of $50,000,000.

MR. GEORGE F. PORTER, master of transportation of the National Electric Light Association, announces that, through the courtesy of Mr. Alex Henderson, master of transportation of the National Electric Contractors' Association, arrangements have been made for the transportation of members of the National Electric Light Association who desire to attend the sessions of the International Electrical Congress, on the special convention train of the National Electrical Contractors' Association. This train will leave the Grand Central station, New York city, at one o'clock, P. M., September 10.

PREMIER BALFOUR, on August 17, delivered the opening address at the annual meeting of the British Association for the Advancement of Science, which this year was held at Cambridge, England. The address was delivered in the Corn Exchange, among those present being the Duke of Devonshire, who is chancellor of the university, and distinguished persons from all parts of Great Britain and the Continent. This is the first time in the history of the association that it has a prime minister as its president. Mr. Balfour delivered an academic paper on the theory of electricity in modern research as applied to the physical universe. In conclusion, the Premier said it was his personal opinion that as natural science grows it leans more and not less upon an idealistic interpretation of the universe. He paid a tribute to the University of Cambridge, toward which he said he might be pardoned if he displayed partiality because it was his own university. The attendance at the meeting of the association this year was larger than that in 1903.

ELECTRICAL SECURITIES.

The unsettled condition of the crop situation and the sensational advances in wheat with the drop in price of steel caused a conservative sentiment at the end of the week. The stock market, however, resisted and yielded only slowly. Consumers of steel products are rather undecided. There seems to be a hope that the present rate-cutting will lead up to something further and to this some of the inactivity is due. Following the period of delay there should be an increased demand and consumption as there was in the steel trade at the beginning of this recent boom. The net result of the reactionary movement was a comparatively small decline in prices. The money market, however, has remained even and there does not seem to be any prospect for an early change. It looks as if there would not be the usual autumnal rise. Notwithstanding a threatened strike on the Manhattan there has been an advance, probably based on the expectation of larger earnings on the subway and elevated lines.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 20.

New York:	*Closing.*
Brooklyn Rapid Transit	52⅜
Consolidated Gas	195¼
General Electric	165
Kings County Electric	210
Manhattan Elevated	154¾
Metropolitan Street Railway	121⅝
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	159¼

In the selling movement Interborough Rapid Transit fell from 1.48 to 1.46 on transactions covering 1,050 shares.

The annual report of the Brooklyn Rapid Transit Company issued on the twentieth was the cause for general satisfaction. The earnings of the company were slightly over $1,000,000, an increase of $246,000 over last year. The report gives stockholders hopes for a dividend as the increase is still being maintained. The cost of operating is at the same time being reduced. The improvements which have been made during the year were the building of four new loops at the Manhattan entrance of the old bridge and the building of a terminal at the Culver yard at Coney Island. The statement for twelve months is as follows: gross, $14,738,709; operating expenses, $8,760,438; net, $5,978,271; other income, $211,852; total income, $6,190,123; taxes and fixed charges, $4,801,214; net income, $1,388,909; special appropriations, $383,706; surplus, $1,005,203.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	263
Massachusetts Electric	60
New England Telephone	123¾
Western Telephone and Telegraph preferred	92

Philadelphia:	*Closing.*
Electric Company of America	9¼
Electric Storage Battery common	62
Electric Storage Battery preferred	62
Philadelphia Electric	6⅜
Union Traction	54¼
United Gas Improvement	88⅛

Chicago:	*Closing.*
Chicago Telephone	123
Chicago Edison Light	145
Metropolitan Elevated preferred	54
National Carbon common	35½
National Carbon preferred	107
Union Traction common	5½
Union Traction preferred	30

The Southside Elevated has called its issue of $750,000 first mortgage bonds for payment November 15 at the Illinois Trust and Savings Bank at 102 and interest. This corporation has placed orders for 35,000 tons of structural material for extension.

Mayor Harrison has written a letter to Judge Grosscup, asking his assistance in getting the Union Traction Company to accept a franchise extension ordinance along the same lines as that now being considered for the Chicago city railway.

TELEPHONE AND TELEGRAPH.

FARGO, N. D.—A telephone line is to be constructed from Kensal to McHenry.

ROCHESTER, N. Y.—The Interocean Telephone Company will consolidate its LeRoy and Pavilion exchanges.

GLENDALE, CAL.—The Home Telephone Company has erected a building to be used for a central office by its valley system.

DENISON, TEX.—The Grayson County Telephone Company's exchange has been damaged by fire to the extent of several hundred dollars.

QUINCY, ILL.—The Illinois Telephone Company and the Pike and Adams County Telephone companies have petitioned the city council for franchises.

MISSOULA, MON.—The Rocky Mountain Bell Telephone Company will at once begin work on its new building on East Main street, to cost $30,000.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has started active work on its new $50,000 exchange and underground system for Green Bay

READING, PA.—The Consolidated Telephone Company, which recently secured a franchise from the council, has begun the work of installing the service.

GENEVA, N. Y.—The Empire State Telephone Company has planned to expend from $30,000 to $35,000 for improvements to its lines and equipment in this vicinity.

HAWKINSVILLE, GA.—L. F. Blassingame, who owns and operates the Hawkinsville and Cochrane exchanges, has closed out his interest at Cochran to the Bell Telephone Company.

LOS ANGELES, CAL.—The Home Telephone Company is installing five new substations, to be completed November 15. These will increase the company's capacity to 20,000 subscribers.

NEW ALBANY, IND.—It is said that the Home Telephone Company, of this city, will install a plant in Jeffersonville, operating under a franchise granted nine years ago to G. H. Voigt, George Holzbog, George Pfau and others.

NATCHEZ, MISS.—The Cumberland Telephone and Telegraph Company is installing a long-distance line between Vidalia and Jonesville, a distance of thirty miles, the line going over public roads and a private right of way.

PEORIA, ILL.—The Central Union Telephone Company is about to spend $80,000 in improvements. Five miles of poles are to be erected and nine miles of aerial cables, and additions will also be made to the company's conduit system.

SENECA FALLS, N. Y.—It is reported that the Bell Telephone Company is to completely overhaul its equipment in this place, and install a modern central energy system. In the principal streets the wires will be put underground.

CONCORD, N. H.—The Weare Telephone Company, with a capital of $3,000, has filed articles of incorporation with the secretary of state. Its intent is to install a telephone line in the towns of Weare, New Boston, Goffstown, Henniker and Hopkinton.

PRESQUE ISLE, ME.—At a hearing given by the selectmen of Presque Isle authority was given to the Farmers' Telephone Company, of Aroostook, to erect poles and construct and maintain its line along the highways and through the village of Presque Isle.

SOUTHAMPTON, N. Y.—The Suffolk County Telephone Company has certified to the secretary of state that its capital stock has been increased from $3,500 to $13,500. The certificate is signed by Walter H. Joycox, R. C. Greene, J. T. Losee, Daniel Chichester and M. F. Tiger.

TAUNTON, MASS.—The New England Telephone Company has been improving the service of its lines in this section, and within a short time Middletown, Seaconnet Point, Portsmouth, Tiverton, Little Compton and Westport Harbor will have a separate system, with an exchange at Little Compton.

DES MOINES, IOWA—The Iowa and the Mutual Telephone companies have adopted rules by which the practice of running overhead cables and wires into buildings in the business district will be done away with as rapidly as possible. Instead all wires will be taken in from the conduits underground.

ROCKFORD, ILL.—The Home Telephone Company now has connection through Beloit with the Badger State Telephone Company and its allied lines. This means the opening up of the whole of southern Wisconsin, as well as direct communication throughout the state and as far north as St. Paul, Minn.

CONCORDIA, KAN.—At the annual meeting of the Northern Kansas Telephone Association, the following officers were elected for the ensuing year: president, J. M. Doyle, Belleville; vice-president, C. W. Baldwin, Osborne; treasurer, G. G. Hill, Concordia; secretary, D. C. Tyler, Clifton.

BRANTFORD, ONT.—The committee appointed by the city council to visit Port Arthur and Fort William and make enquiries concerning a telephone system has brought in a report recommending that such a system be installed in this city. It was also recommended that the city control its own electric lighting plant.

CLIFTON SPRINGS, N. Y.—At a recent meeting of the owners and managers of the Shortsville, Manchester, Clifton Springs and Phelps telephone exchanges, arrangements were made for the interchange of business between the different companies concerned. The system includes ten villages, with over 1,300 subscribers.

NEWARK, OHIO—The Gratiot & Brownsville Telephone Company has signed a contract with the Newark Independent Telephone Company for the interchange of toll business. The Gratiot company proposes to connect Linnville, Brownsville, Gratiot, Mount Sterling, White Cottage and other places, and also give communication with Zanesville.

ST. JOSEPH, MO.—Improvements and extensions in the equipment of the Missouri & Kansas Telephone Company, now in progress, will entail an expenditure of about $100,000. A new switchboard is to be installed, and the company is spending $15,000 in the construction of additional lines in the city. The switchboard will have a capacity of 3,000 telephones.

WHEELING, W. VA.—Arrangements have been completed whereby the National Telephone Company will have direct connection with the Enterprise Telephone Company, of New Martinsville. This will give the subscribers of the National company connection with New Martinsville, Sistersville, Middlebourne and a number of other towns on the line of the West Virginia Short Line Railroad.

CANANDAIGUA, N. Y.—At the annual meeting of the directors of the Seneca-Gorham Telephone Company, held at Stanley, it was voted to increase the capital stock from $10,000 to $30,000. The election of officers resulted as follows: president, John A. Driscoll, of Rochester; vice-president, D. S. Allen, of Hallis; secretary and treasurer, Rice Macauley, of Stanley; auditor, D. A. Allen, of Gorham. The company's lines are to be extended to Bellona.

SAN BERNARDINO, CAL.—The Arizona, Nevada & Southern Telephone Company has applied for permission to erect a telephone line from a point near Needles to San Bernardino, connecting all towns between the two places along the line of the Santa Fe Railroad. It is the intention of the company to reach all the important mining camps on the Mojave Desert, and eventually to extend the system into Nevada and Arizona. The company is now operating exchanges at Needles and Kingman.

ELKTON, MD.—At a special session of the county commissioners permission was granted the Cecil Farmers' Telephone Company to erect poles and string wires on the margin of the public roads in Cecil County. The company was chartered by the last legislature. The incorporators, who have since been elected directors, are: Elwood Balderston, Alfred B. McVey, Morris C. Reeder, Cecil E. Ewing, James H. Maxwell, Joseph T. Grove, John P. Wilson, Alfred Kirk, Robert Cameron, Frank R. Cherry, Robert K. Rawlings, Aaron J. Michiner, Joseph S. Scarborough, J. Harry Maxwell, Martin L. Thompson and J. Harry Poist. The charter provides that the capital stock shall not exceed $2,500, divided into 100 shares of $25 each, with the privilege at any time to increase the capital stock to $50,000, should two-thirds of the stockholders approve the increase.

ELECTRIC RAILWAYS.

MULLICA HILL, N. J.—It is stated that the trolley line which runs to Mantua will be extended to this town at an early date.

PITTSBURG, PA.—The Schuylkill Valley Traction Company has secured the necessary right of way to build an extension to Pottstown, Pa.

[illegible], S. D.—Capitalists are said to be agitating the building of a trolley line between Sioux Falls and Egan, and from Egan to Brookings.

PHILADELPHIA, PA.—The West Chester Traction Company has under consideration the building of a branch line from a point on the West Chester pike to Media.

SANTA CRUZ, CAL.—The Santa Cruz electric car line, recently purchased by T. S. Granger, will be consolidated with the Santa Cruz, Capitola & Watsonville line.

MANITOWOC, WIS.—The Manitowoc & Northern Traction Company has completed a resurvey of the proposed extension of its lines in the west limits of the city and work has been commenced.

CARROLLTON, OHIO—The city council has granted an electric railway and power and lighting franchise to Chicago capitalists. They will construct the Canton, Carrollton & Steubenville Electric Railway.

JACKSON, MISS.—A company has been organized in the southwestern part of the state to build an electric line from Fort Adams to Centreville *via* Woodville. The company is capitalized at $500,000.

JACKSON, MICH.—The common council of Alma, Mich., has granted a franchise for the construction of an electric road connecting Alma, St. Louis and Ithaca. The franchise was granted in the name of Frank M. Ohl.

SPRING LAKE, N. J.—The new extension of the Atlantic Coast Railway from this place to Belmar has been put in operation. This completes the line from Matawan to Spring Lake, a distance of about twenty-five miles.

LOWVILLE, N. Y.—The board of directors of the Lowville & Beaver River Railroad Company has let the contract for the construction of the road. It is estimated that five or six months will be needed for this work.

PLAINFIELD, N. J.—The Morris County Traction Company has been granted a franchise to build a trolley line through Union township to connect at Springfield with the proposed road which will run to Summit and into Morris County.

JACKSON, MISS.—The Greenville & Leland Electric Railroad, which proposes to build a line from Greenville to Leland, in Washington County, has been incorporated by Morris Rosenstock, of Greenville, and J. W. Thompson, of Leland.

KALAMAZOO, MICH.—The Kalamazoo & Lake Shore Traction Company has been granted a franchise by the city council. The franchise provides that the company is to come into the city over the tracks of the Michigan Traction Company.

FALL RIVER, MASS.—The capacity of the Warren power-house of the New York, New Haven & Hartford Railroad is to be doubled. A contract for enlarging the building and installing two steam turbines of 1,000 horse-power each was awarded recently to the Westinghouse interests.

LONG ISLAND CITY, L. I.—Sufficient consents have been obtained from property owners on Thomson avenue and the Hoffman boulevard, in the town of Newtown, to permit the New York & Queens County Railroad to lay its tracks over those highways in a continuous line from Long Island City to Jamaica.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company has taken out a permit for a $100,000 power station to be a duplicate of the new station on Commerce street. The new building will be, in fact, an addition to the present structure. It will cover an area of 83 by 144 feet and will be four stories in height.

MOUNT HOLLY, N. J.—Joseph Stokes, Joseph Lippincott, Israel Roberts, James L. Trimble, Albert C. Heulings and William D. Lippincott, of Moorestown, have formed the Moorestown Rapid Transit Company, for the purpose of securing improved trolley and train service between that place and Camden. A certificate of incorporation has been filed in the county clerk's office here.

READING, PA.—A civil engineer and interested capitalists from Philadelphia have made a second tour of a proposed trolley line between here and Nernville. It is proposed to carry freight as well as passengers. The company is to be capitalized at $350,000 and bonded by the Philadelphia capitalists. The road has already been mapped out as far as Mt. Pleasant.

ATLANTA, GA.—For the year ended June 30, 1904, the Georgia Railway and Electric Company earned gross $1,971,981; net after interest and taxes, $383,970, which amounts to five per cent upon the outstanding $2,400,000 preferred stock and four and one-quarter per cent upon the $6,014,600 of common stock. The company owns all the city and suburban electric railways, electric light and gas companies of Atlanta, Ga.

WAPAKONETA, OHIO—A number of capitalists in this part of the state are planning a new electric line to run between Defiance and this city or between Defiance and St. Marys. Two preliminary surveys have been made between these points, the survey between St. Marys and Defiance passing through Spencerville, Wetsel, Delphos, Grover Hill, Oakwood and Paulding. The line as proposed passes through territory not yet traversed by any other railroad.

ALBANY, N. Y.—The Buffalo & Southeastern Railway Company has been incorporated with a capital of $300,000, to operate a street surface railway line from the village of East Aurora to Buffalo, passing through Spring Brook and Ebenezer, a distance of twelve miles. The directors are: Fay H. Ball, E. E. Henshaw, Densmore Pratt and James Cadzaw, of East Aurora; T. S. Miller, B. J. Cole, J. B. Kennedy and O. R. Blair, of Buffalo, and J. L. Baker, of Ithaca.

WILKESBARRE, PA.—The Danville & Sunbury Trolley Company, a new corporation, has started survey work at South Danville. Clyde C. Yetter, of Bloomsburg, is president of the company; Isaac Hagenbuch, of Bloomsburg, secretary, and W. A. Heller, of Danville, treasurer. The directors are C. P. Hancock, of Danville; James Coleman, of Bloomsburg, and Howard Weiss, of Siegfried. No route has been definitely decided upon, and will not be until the survey has been completed.

CORTLAND, N. Y.—The stockholders of the Cortland County Traction Company and the Cortland & Homer Electric Company held their annual meeting July 30, when officers for the traction company for the ensuing year were elected as follows: president, Frank Battles, of Philadelphia; first vice-president, E. H. Brewer; second vice-president, Hugh Duffy; secretary and treasurer, Edwin Duffy. B. F. Taylor was elected president of the electric company and Edwin Duffy secretary and treasurer.

PERU, IND.—A new electric line is being projected between Marion and Logansport, by the way of this city, with Logansport and Fort Wayne capital back of the enterprise. J. W. Wilson, of Fort Wayne, and Herbert L. Mossrock, of Logansport, are said to be pushing the project. It is proposed to run the road through Somerset and Peoria, *en route* to Peru, and then west over the Fort Wayne & Wabash Valley Traction line. It is believed that work on this new line will be commenced by October 1.

HARTFORD, CT.—Engineers have been surveying a route for the trolley line which the Woodbury & Waterbury Street Railway Company proposes to build from Woodbury through the town of Middlebury to Waterbury. Options are now being secured on needed rights of way. The company, which has a very broad charter, was incorporated by the last general assembly, and it has a capital stock of $200,000. If the line is built it will be operated in affiliation with the Waterbury system of the Connecticut Railway and Lighting Company.

CLEVELAND, OHIO—A new trolley line is being built from Norwalk south to Plymouth, Ohio, by way of North Fairfield and Chicago Junction, a distance of twenty-four miles. The new road is being built for the Sandusky, Norwalk & Mansfield Railway and Light Company. At Norwalk the road will connect with the Lake Shore Electric Railway, and at the other end the Citizens' Railway and Light Company will give it a connection with Mansfield, as soon as the latter road is completed through to Plymouth. It is expected that the road will be in operation through part of its territory late this fall.

INDUSTRIAL ITEMS.

THE GENERAL CONSTRUCTION COMPANY, Seattle, Wash., seeks to interest the placer mining public in its catalogue No. 2, of Bewsher sand pumps.

THE MINERAL PRODUCTS MANUFACTURING COMPANY, Wilmington, Del., has moved, and is now located in its new and specially equipped building at C and Buttonwood streets.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in its August calendar of the great men of science and engineering series, publishes a biographical sketch of Dr. Michael I. Pupin.

CHARLES E. PEASE is the general agent for a very efficient electric pump. This pump maintains the water supply automatically and it is specially adapted for office buildings, apartment houses and residences.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has issued a very well printed booklet showing illustrations of its instruments and works; and also bulletin No. 1030, concerning Bullock transformers.

THE AUTOMATIC TELEPHONE EQUIPMENT COMPANY, Boston, Mass., has issued a booklet called "A Girlless Telephone Proposition." It covers the field of the automatic telephone. This catalogue will be mailed upon receipt of twelve cents.

THE FEDERAL ELECTRIC COMPANY, Erie, Pa., has removed its office and factory to Girard, Pa. Modern facilities and additional shop equipment will enable the company to increase its output and handle orders with the greatest efficiency.

FRANK B. GILBRETH, general contractor for architectural and engineering construction, has moved his New York offices to 34 West Twenty-sixth street. Mr. Gilbreth is mailing booklets showing fine views of some recent work directed by him.

THE WARD-LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued as parts of its perpetual catalogue, circulars No. 19046, on "OF" type ceiling fan controllers; 19047, "SKFN" type controlling panel, and catalogue 19043—circuit-breakers.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburg, Pa., publishes its usual attractive calendar for August and also a booklet, giving testimonials from users of its instruments, showing their satisfactory behavior during lightning storms and after being struck by lightning.

ROSS & COMPANY, New York, have recently issued a very fine catalogue entitled "Mechanical Stokers." A valuable feature of these machines is that the parts liable to be destroyed or injured by the fire are made in removable sections, easily replaced at a minimum cost.

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA, Troy, N. Y., has recently installed in its works new machinery for the assembling of its insulated rail joints, and also the new insert bond which is being placed upon the market. The company has a very large exhibit at the St. Louis Exposition.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has closed contracts for switchboards for the Pfister Vogel Leather Company and Davis & Means, Delmar, Iowa, Fayette Telephone Company, Fayetteville, Tex., and the Shelby Telephone Company, Shelby, Mo.

THE SPRAGUE ELECTRIC COMPANY, New York, has sold to the Hammerschlag Manufacturing Company, Newark, N. J., an additional order consisting of one 150-kilowatt generator and twelve motors ranging from one to fifty horse-power. This machinery is for use in the Hammerschlag wax paper plant, one of the largest of its kind in the country.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., manufacturers of the "Wood" systems, have issued bulletins No. 1056, descriptive of the type A transformers, and No. 1057, of the multiphase revolving field belted generators and type AE rheostat; also catalogue 2010, of parts for the alternating-current, 104-volt form C "Wood" arc lamps.

WATERBURY & COMPANY, New York city, have issued bulletins Nos. 1 and 2, descriptive of their panel boards and switches. The latter meet the requirements of the National Board of Fire Underwriters and the Factory Mutual Insurance Company. These instruments possess the qualifications usually sought by the trade, and promise to be very popular.

THE EDISON ELECTRIC ILLUMINATING COMPANY of Brooklyn publishes a list of nine charging stations which it has established for the convenience of users of electrical automobiles in Brooklyn. In addition, is published a list of twelve other stations located in Brooklyn where batteries may be charged. Customers are advised to carry their own charging plugs as there are several varieties in use.

THE COLLINS MANUFACTURING COMPANY, Conshohocken, Pa., publishes a catalogue descriptive of its automatic oil filtering and oiling system, and also of its automatic damper regulator. For the latter it claims that it is sensitive, a fuel saver, of simple construction, will work with steam, water or air pressure, and will positively hold the steam pressure within a variation of one pound of the point desired.

THE OTIS ELEVATOR COMPANY has been awarded a contract for installing in a large Boston department store, the president of which is Henry Seigel, ten moving stairways. There will be two lines of "escalators" running between the basement and the fifth floor, five up and five down. By a special mechanism the descending escalators can be reversed and utilized for carrying passengers up instead of down.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., has issued a handsome exposition edition of its power press catalogue. The Bliss company, in addition to being the largest manufacturer of sheet metal working machinery in the world, is also the exclusive manufacturer for the United States navy of the Whitehead automobile torpedoes, launching tubes, air compressors and appliances. The company is considering the manufacture of automobiles.

THE HENRY R. WORTHINGTON COMPANY, New York, publishes a small map showing the location of its old works in South Brooklyn, its offices in Manhattan, and new works in Harrison, N. J., with the intercommunicating lines of transportation. The old works, founded in 1840, employed 2,000 men. The new plant will give an addition of eighteen acres of floor space and will accommodate 6,000 workmen. It is said to embrace the latest improvements in productive engineering.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to the trade a catalogue of "Columbia" crystal lamps with metal reflectors. These lamps are also equipped with "Prismo" glass shades. The Central Electric Company is sales agent for "Columbia" incandescent lamps, and the addition of the crystal type will greatly increase the popularity of the standard lamp. The company reports a satisfactory lamp business, and states that this is due to the reliability of the "Columbia" filament.

ROGERS & STARR, 827 Perry Building, Philadelphia, Pa., have engaged in active business as general contractors and engineers. Mr. Rogers is a graduate of Cornell University, and in past years has been connected with the Baldwin Locomotive Works, Boston & Albany Railroad Company, Latrobe Steel Company, and Ballinger & Perrot. Mr. Starr was heretofore connected with the Camden & Suburban Railway Company, Pottstown, Pa., and has had an extended experience in telephone engineering and in railway work. The company will make a specialty of civil engineering, mechanical and electrical engineering, and the installation of power plants.

THE ECONOMICAL ELECTRIC LAMP COMPANY, New York, in connection with the infringement suits brought by the Phelps Company, of Detroit, against certain of its patrons, advises that it is pleased to have the opportunity now offered of having the validity of the patents held by the Phelps Company adjudicated by the court. It also advises that it has assumed the defence of the suits brought by the Phelps Company up to this time, and that it is ready to assume the defence of any further suits which may be brought against its patrons, inasmuch as it claims that the patents in question were examined by its patent counsel, and that in his belief it has a strong defence as the lamp manufactured by the Economical Electric Lamp Company did not infringe, because of prior patents issued in this country and England.